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ANNALS

OF THE

ASTRONOMICAL OBSERVATORY OF HARVARD COLLEGE.

VOL. III.

CAMBRIDGE:
WELCH, BIGELOW, AND COMPANY,
PRINTERS TO THE UNIVERSITY.
1862.

ACCOUNT

OF THE

GREAT COMET OF 1858.

BY

G. P. BOND,

DIRECTOR OF THE OBSERVATORY OF HARVARD COLLEGE.

CAMBRIDGE:
WELCH, BIGELOW, AND COMPANY,
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1862.

SUBSCRIBERS

TO THE THIRD VOLUME OF THE ANNALS OF THE OBSERVATORY OF HARVARD COLLEGE,

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Letter-Press.

JOSIAH QUINCY, Boston.

Engravings.

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AMOS A. LAWRENCE,	"	N. THAYER,	"
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GEORGE W. LYMAN,	"	J. INGERSOLL BOWDITCH,	"

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INTRODUCTION.

Few departments of astronomy have been pursued with greater industry and success, or have participated more fully in the general advance of the science, than the investigation of the motions of comets in our system. Nothing which labor and skill can supply has been wanting to secure exactness in the determination of their places in the heavens, and in the reduction of the elements directly dependent upon observation to a form suitable for theoretical discussion. The development of the theory of their motions has also been carried to a high degree of perfection, and has furnished methods of calculation, by which their courses are represented and predicted with a degree of accuracy only limited by the necessary uncertainties of the observed positions.

When, however, the physical organization of comets becomes the special object of inquiry, and the attention is directed to almost any of their characteristics distinguishable from the simple motion of their centres of gravity about the Sun, we find an extensive field of research which has scarcely yet been entered upon. Of the laws which govern the mysterious evolutions of comets, we know little beyond the uncertain information suggested by conjecture and analogy; we are still at a loss to account for some of the simplest features of their aspect, and have not even arrived at a clear and definite statement of the facts of their phenomena which should be subjected to theoretical discussion.

That so little has been accomplished towards a solution of questions relating to the internal structure and constitution of comets, is plainly not to be attributed to any want of interest in the subject itself, for it would be difficult to point out in the entire range of astronomical research any problem presenting greater attractions. There is something in their vast proportions, in the suddenness of their apparition, and in the mystery of their nature, well calculated to arrest attention, even where there is little disposition to intelligent observation.

Thus in ancient times we find them invested with a supernatural character, and their aspect and path among the stars, recorded with anxious solicitude, have served to carry back their annals to a remote period. The more correct views of their nature and offices now entertained have given a new direction to this interest; but they can scarcely be said to have had any tendency to diminish it.

Undoubtedly there have existed peculiar difficulties both in the observation and in the theory, which by a mutual reaction have impeded the progress of both. Without a theory or some form of hypothesis containing the elements, at least, of truth, and capable of definite statement in time and number, to serve as a connecting principle between isolated phenomena, and to direct attention to those points where it can be best exercised, the observer is working at a great disadvantage; he has no intelligent comprehension of the object of his labor, and cannot concentrate it where it will be most effective. The mere accumulation of observations without system or special aim, can never contribute much to the advancement of any branch of knowledge, and it is particularly out of place here, where the details of the phenomena are usually faint and indistinct, and therefore peculiarly exposed to influences conveying either wholly erroneous impressions, or else exaggerated and distorted conceptions of real features imperfectly seen.

The latest series of observations have alone had the advantage of the suggestions and guidance of theory. The views advanced by Bessel in his researches upon Halley's Comet, published in 1836, have had a useful influence, especially in giving a more definite form to the process of investigation, and a clearer aim and purpose to the observations.

The difficulty of giving an exact and intelligible description of the various features presented by comets, even where there has been nothing to prevent their distinct recognition, should also be mentioned. The data in many cases are not susceptible of explicit numerical statement, and it is equally impracticable to express in language all that it is desirable to put on record; resort must therefore be had to drawings to illustrate and explain the written account. But besides that the correct execution of the original sketches is a task of no small difficulty, not merely from want of skill on the part of the draughtsman, but also from various annoyances incident to the circumstances of the observation, there remains still the further impediment that the transfer of the figures to engravings is both troublesome and expensive. The consequence is, that the latter are commonly omitted, or, if published, are often so coarsely and erroneously executed as to become mere caricatures of the intended object. The very knowledge of such

impediments of course operates as a discouragement to observers to attempt the delineation of comets, and thus comparatively little advantage has been gained from one of the most effective means of securing a full and clear record of their development.

From the time of the publication of Bessel's investigations upon the Comet of Halley, no comet of the largest class appeared under conditions suitable for bringing the theory to a decisive test, until 1858. The Great Comet of that year, besides being in other respects a fine example of its class, was singularly favored in the circumstances attending its apparition. Its early discovery, while yet a faint telescopic object, enabled astronomers to predict its future course, and, in some measure, to anticipate the extraordinary development in size and splendor which awaited its nearer approach to the Sun. Attention was thus naturally directed to the earliest indication of those remarkable evolutions of which the previous accounts of these bodies had preserved only obscure intimations. The time of perihelion passage, and the position of its orbit relatively to the Earth's path, concurred in giving a most effective presentation of its size and proportions; this will be better understood by referring to the accompanying Plate (Plate I. Intr.), representing a projection of the orbit of the Earth upon that of the Comet, and of the orbit of the Comet upon that of the Earth.

From the 2d of June to the 8th of September, the Earth was on the north side of the plane of the orbit. It crossed the line of nodes on the last-named date, giving an opportunity for observations on the figure of a section of the tail, in a plane at right angles with the orbit, and upon other interesting features. After the middle of September, the tail was presented in nearly its full-length proportions; within a day or two of the perihelion passage, which took place on September 30th, the axis was brought to a position at right angles to the line of vision, and ten or twelve days later, when the Comet had reached its least distance from the Earth, its profile was almost precisely that of a section in the plane of the orbit. Where so little is known, *a priori*, respecting the actual figure, there is an obvious advantage to be derived from these accidental circumstances of its position, by which the influence of perspective foreshortening has been in a great measure eliminated.

Among other well-timed conditions may be mentioned the absence of moonlight, and the short duration of twilight in the evening sky at the most important period of the apparition; it deserves notice, too, that the fainter parts of the tail were projected upon a region of the heavens where there was little extraneous

light, such, for instance, as that of the Milky-Way or Zodiacal Light, to distract the attention and interfere with the correct tracing of its limits.

But the circumstance which contributed most effectually to the value, as well as to the number, of the observations, was the general prevalence of clear weather in Europe and America at the time when the Comet was at its most interesting stage; only two dates occur, in the statement of the original data given in this volume, without a record relating either to the appearance of the tail or to the telescopic view, between the 28th of August and the 27th of October inclusive. We may add further, that the zone of the Earth's surface best placed for viewing the Comet included the great centres of civilization, where were to be found, of course, the chief facilities for observation.

In the present imperfect state of our knowledge respecting these bodies, it would not be easy to overrate the value of the opportunity which here offered itself for securing a full and authentic history of the development of a first-class Comet; nor does it appear that astronomers were insensible of its importance. The increased facilities afforded by modern instruments have been everywhere employed in recording the details of the phenomena, and a great mass of materials illustrating the various phases and transformations of the Comet has been accumulated for future discussion. In the essential elements of accuracy and fulness of detail, in the long interval of time for which it furnishes a connected record, and in the variety of interesting features described, this collection is, beyond any comparison, the most valuable which we possess, and, to judge by past experience of the many chances against a similar recurrence of favoring conditions, it may long retain its distinction.

In order to make these materials available to their full extent for the purposes of theoretical investigation, it is proposed in the present volume to bring the observations together under a systematic arrangement, so that they may be easily accessible for reference and comparison; to subject them to a suitable reduction, in order to eliminate errors and bring to light the more evident relations of the phenomena; and finally, to unite them in a continuous history based upon this discussion. The opportunity will be taken to give in detail the observations made at the Observatory of Harvard College, the greater part of which are now for the first time published, together with a valuable collection of other matter which has been communicated in manuscript from various sources elsewhere acknowledged.

The plan which has been pursued in carrying out this object may be gathered from the subjoined list of the titles of the several Sections of the work. The

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[illegible] bodies, it [illegible] have offered [illegible] of a first-class [illegible] of its importance. [illegible] been everywhere [illegible] mass of ma- [illegible] has been [illegible] and ful- [illegible] a connected [illegible] collection is, [illegible] to judge by [illegible] of favoring [illegible]

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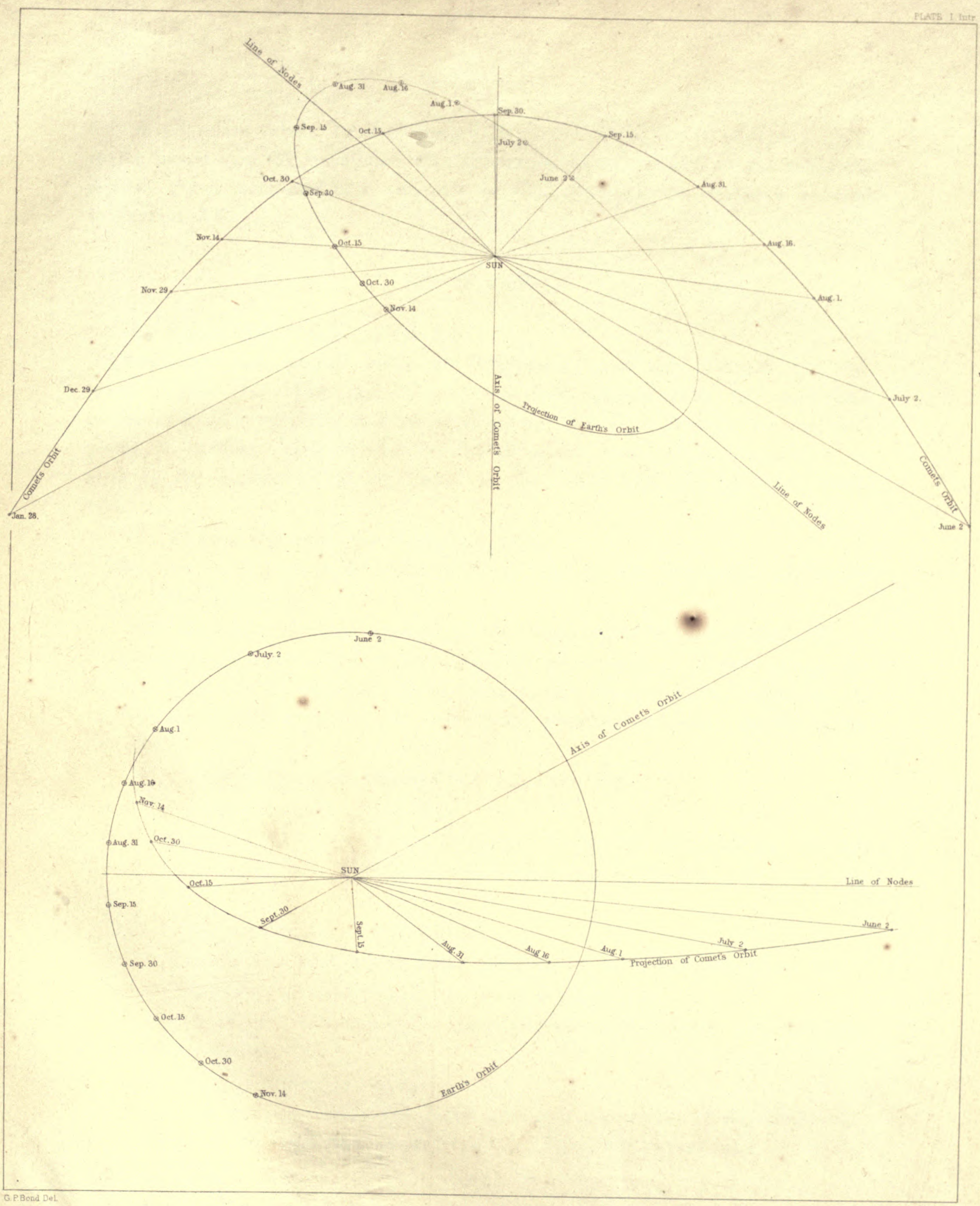
[illegible] may be gathered [illegible] the work. The



G. P. Bond Del.

J. W. Watts Sc.

COMET OF DONATI 1858.

PROJECTION OF EARTH'S ORBIT UPON COMET'S ORBIT
PROJECTION OF COMET'S ORBIT UPON EARTH'S ORBIT

Printed by Chas. D. Andrews

first seven relate chiefly to the appearance of the Comet as it presented itself to the naked eye, the remainder, with the exception of the last, to the telescopic aspect. For a more complete summary of their contents, the reader is referred to Section XV.

Titles of Sections.

I. Figure and Position of the Tail.

Comprising the original notes of observation upon the principal tail, between August 14, 1858, and February 9, 1859, quoted with full references to the original authorities, and accompanied by remarks indicating the principal points of interest. This Section is illustrated by twenty-three engravings on steel of the appearance of the Comet to the naked eye, and by eight woodcuts.

II. Observations upon the Secondary Tails.

The text is illustrated by three woodcuts, and by the engravings and charts of the naked-eye views.

III. Reduction of Observations upon the Figure and Position of the Tail.

The results of the discussion are exhibited on a series of Charts giving the normal outlines of the principal tail on twenty-eight dates, between September 16 and October 17 inclusive, and the axis of the principal secondary tail for seventeen dates.

IV. Probable Errors of Observations upon the Tail.

V. On the Deflection of the Tail.

Describing a peculiarity in its upper regions during the first and part of the second week in October. Two plates of outlines and a woodcut accompany the text.

VI. Columnar Structure of the Tail.

Relating to a remarkable feature faintly exhibited in the upper part of the tail.

VII. Reduction of Observations on the Secondary Tails.

The results of this discussion have been entered on the Charts with the outlines of the principal tail.

VIII. The Nucleus and Envelopes.

The original accounts descriptive of the telescopic appearance of the Comet are here quoted in the same form as in Section I. They are accompanied by twenty steel engravings.

IX. On the Outline of the Head of the Comet.

The discussion is illustrated by two plates showing the normal outlines of the head of the Comet between September 3d and October 18th.

X. On the Branches and Central Darkness of the Tail.

Engravings of nine views of the Comet 1860, III. are given in this Section.

XI. The Nucleus.

Containing a description of the nucleus, with particular reference to its size and changes of brightness.

XII. The Envelopes.

The various phenomena of the envelopes, their velocity of ascent, the dark and bright spots on their surface, and the question of their rotation or oscillation, are considered in this Section, which is illustrated by a lithographic plate of one hundred and thirty-eight telescopic views. The Section concludes with a notice of the envelope-formation in the Comet 1860, III. and in the great Comet 1861, II., accompanied by a steel engraving of the former.

XIII. The Outer Faint Veil.

Containing an account of this feature, with a reference to a similar peculiarity in the Comet 1860, III.

XIV. On the Direction of the Initial Axis of the Tail.

XV. Conclusion.

This Section gives a general summary of the contents of the volume.

The sources from which the observations have been derived are given in the subjoined list of authorities.

I am indebted to the kindness of R. C. Carrington, Esq., Secretary of the Royal Astronomical Society, for copies of unpublished drawings of the Comet in the possession of the Society, and to G. B. Airy, Esq., Astronomer Royal, for copies of drawings made at the Royal Observatory, Greenwich.

My acknowledgments are also due to Dr. C. H. F. Peters, of Hamilton College Observatory; to Dr. F. Brünnow, Ann Arbor, Mich.; Hon. Wm. Mitchell, of Lynn, Mass.; Rev. J. G. Adams, of Worcester; Rev. James Challis, of Cambridge, Eng.; Rev. W. R. Dawes, of Haddenham, Eng.; William Lassell, Esq., of Bradstones, Liverpool; Edward Cooper, Esq., of Markree Castle, Ireland; Baron de Forrester, of Oporto; Prof. Heis, of Münster; J. F. J. Schmidt, of Athens; R. L. J. Ellery, Esq., of Melbourne, Australia; and to P. Secchi, of Rome, for the communication of various drawings and other materials relating to the Comet, not hitherto published, which will be noticed more particularly in the annexed list.

List of Authorities for Observations, Drawings, &c. used in this Work.

ADAMS,	Worcester, Mass.,	Photographic copy from a drawing of the Comet.
AIRY,	Greenwich, Eng.,	*Monthly Notices Royal Astr. Soc.*, Vol. XIX. Also pencil copies of seven telescopic views of the Comet taken at the Royal Observatory, Greenwich.
ARNOUX,	Brelum, Camboja,	*Comptes Rendus*, Vol. XLVIII.
D'ARREST,	Copenhagen,	*Oversigt kgl. danske Videnskabernes Selskabs*, 1858.
AUWERS,	Göttingen,	*Astron. Nachrichten*, 1167.
BOND, W. C.	Obs. Harv. Coll.,	Mss. notes of observations and drawings of the Comet.
BOND, G. P.	" "	" " " " " " "
BOND, R. F.	" "	" " " " " " "
BREEN,	Cambridge, Eng.,	*Monthly Notices Royal Astr. Soc.*, Vol. XIX.
BRUHNS,	Berlin,	*Astron. Nachrichten*, 1161 and 1205.
BRÜNNOW,	Ann Arbor, Mich.,	Mss. notes and sketches of the envelopes on five dates with particular reference to the secondary nucleus.
BURR,	Highbury, Eng.,	*Monthly Notices Royal Astr. Soc.*, Vol. XIX.
CALLOW,	Ship "Charles,"	" " " " "
CHACORNAC,	Paris,	*Bulletin Obs. Imp. de Paris.*
CHALLIS,	Cambridge, Eng.,	*Monthly Notices Royal Astr. Soc.*, Vol. XIX. Also an impression from a plate of ten telescopic views of the Comet forwarded in advance of publication.
CHIMNO,	Carbost, Isle of Skye,	*Monthly Notices Royal Astr. Soc.*, Vol. XIX.
CHRISTY,	Greenwich,	" " " " " Also copies of drawings of the Comet. See Airy.
COOPER,	Markree,	*Obs. Donati's Comet* 1858, *Markree.* Also remarks in Mss., additional to printed account.
COSTA,	Berg. de Guer. "Ancud,"	*Astron. Nachrichten*, 1182.
DAWES,	Haddenham, Eng.,	*Monthly Notices Royal Astr. Soc.*, Vol. XIX. Also a valuable series of five crayon drawings of telescopic views of the Comet, with notes in Mss.
DE LA RUE,	Cranford,	*Monthly Notices Royal Astr. Soc.*, Vol. XIX.
DONATI,	Florence,	*Bulletin Obs. Imp. de Paris.*
ELLERY,	Melbourne, Australia,	Lithographs and photographic copies of thirteen drawings of the Comet, giving its appearance in the southern hemisphere at near the close of the apparition.
FEARNLEY,	Christiania,	*Astron. Nachrichten*, 1242.
FETTE,	Obs. Harv. Coll.,	Eight drawings in chalk of the naked-eye and telescopic views.
FORRESTER, BARON DE,	Oporto,	Copies in water-color, and tracings of eleven naked-eye views.
FÖRSTER,	Berlin,	*Astron. Nachrichten*, 1205.
GALLE,	Breslau,	" " 1179.
GRAHAM,	Markree,	*Obs. Donati's Comet* 1858, *Markree.*

GRAY,	York, Eng.,	*Monthly Notices Royal Astr. Soc.*, Vol. XIX.
GROVE,	. . . . .	" " " " "
GUNDIAN,	Berg. de Guer. "Ancud,"	*Astron. Nachrichten*, 1182.
HALL,	Obs. Harv. Coll.,	Mss. notes of observations.
HARTNUP,	Liverpool,	*Monthly Notices Royal Astr. Soc.*, Vol. XIX.
HEIS,	Münster,	*Astron. Nachrichten*, 1169. Also Mss. chart of seven outlines of the tail of the Comet among neighboring stars, with notes.
HIND,	Regent's Park, London,	*London Times.*
HOEK,	Leyden,	*Astron. Nachrichten*, 1186.
HODGSON,	. . . . .	*Monthly Notices Royal Astr. Soc.*, Vol. XIX.
HORNSTEIN,	Vienna,	*Annalen der k. k. Sternwarte in Wien*, F. III. IX.
JEANJAQUET,	Neuchatel,	*Souvenirs de la Comète de* 1858.
KENDALL,	Meadville, Pa.,	Monochromatic landscape view, with Comet and stars.
LAIS,	Dorpat,	*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV.
LASSELL,	Bradstones, near Liverpool,	*Monthly Notices Royal Astr. Soc.*, Vol. XIX. Also five pencil copies of telescopic views of the Comet, with Mss. notes.
LAMONT,	Munich,	*Jahresbericht der k. Sternw. München.*
LIAIS,	Rio Janeiro,	*Comptes Rendus*, Vol. XLVIII.
LISTING,	Göttingen,	*Astron. Nachrichten*, 1167.
LITTROW,	Vienna,	*Annalen der k. k. Sternw. Wien*, F. III. IX.
LOGAN,	Sacramento, California,	*Astron. Journal*, No. 119.
LOVERING,	Obs. Harv. Coll.,	*Proceedings Am. Academy*, Vol. IV.
LUFF,	Oxford, Eng.,	*Cycle of Celestial Objects, continued to* 1859.
MACLEAR,	Cape of Good Hope,	*Memoirs Royal Astr. Soc.*, Vol. XXIX.
MÄDLER,	Dorpat,	*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV.
MAIN,	Greenwich,	*Monthly Notices Royal Astr. Soc.*, Vol. XIX.
MOESTA,	Santiago, Chili,	*Astron. Nachrichten*, 1257.
OUDEMANS,	Batavia,	" " 1183.
PAPE,	Altona,	" " 1160, 1172, 1173, 1174.
PETERS,	Obs. Ham. Coll., N. Y.	A valuable collection of Mss. notes on the Comet, with copies of four large telescopic views.
PLANTAMOUR,	Geneva,	*Note sur la Comète de Donati.*
POEY,	Havana,	*Comptes Rendus*, Vol. XLVIII.
POWELL,	Madras,	*Monthly Notices Royal Astr. Soc.*, Vol. XIX.
POGSON,	Oxford,	*Cycle of Celestial Objects, continued to* 1859.
RESLHUBER,	Kremsmünster,	*Astron. Nachrichten*, 1169.
ROBERTSON,	Markree,	*Obs. of Donati's Comet*, 1858.
ROSA,	Collegio Romano,	*Mem. dell' Osserv. del Collegio Romano*, 1859.
RONZONI,	Padua,	*Comptes Rendus*, Vol. XLVIII.
SCHMIDT,	Vienna,	Measurements of the envelopes, &c., with notes in Mss.
SCHWABE,	Dessau,	*Astron. Nachrichten*, 1165.
SEARLE,	Albany,	*Astron. Journal*, 119, 127.
SECCHI,	Collegio Romano,	*Mem. dell' Osserv. del Collegio Romano*, 1859. Also a copy of a naked-eye view of the Comet, with neighboring stars.

SEIDEL,	Munich,	*Astron. Nachrichten,* 1193.
SELBY,	Spalding, Eng.,	*Monthly Notices Royal Astr. Soc.,* Vol. XIX.
SLATTER,	Oxford, Eng.,	" " " " "
SMYTH,	Aylesbury, Eng.,	*Cycle of Celestial Objects, continued to* 1859.
STAMPFER,	Vienna,	*Astron. Nachrichten,* 1159.
STRUVE, O.	Poulkova,	*Pulk. Beob. des Grossen Cometen* 1858.
SWIFT,	Hunt's Corners, N. Y.,	*Astron. Journal,* 118.
TENNANT,	Mussooree, India,	*Monthly Notices Royal Astr. Soc.,* Vol. XIX.
TOOMER,	Albany,	*Astron. Journal,* 119, 127.
TROWBRIDGE,	Perry City, N. Y.,	" " 118.
TUTTLE,	Obs. Harv. Coll.,	Sketch of the Comet to the naked eye.
USHERWOOD,	Walton Common, Eng.,	*Monthly Notices Royal Astr. Soc.,* Vol. XIX. Also copy of photograph of the Comet.
VALZ,	Marseilles,	*Bulletin Obs. Imp. de Paris.*
WEBB,	Tretire, Eng.,	*Monthly Notices Royal Astr. Soc.,* Vol. XIX.
WEISS,	Vienna,	*Annalen der k. k. Sternwarte in Wien,* F. III. IX.
WILLIAMSON,	Kingston, C. W.,	*Canadian Journal,* III.
WINNECKE,	Poulkova,	*Pulk. Beob. des Grossen Cometen* 1858.
WÜLLERSTORF,	Frigate "Novarra,"	*Astron. Nachrichten,* 1190.

The Poulkova observations deserve particular mention for the fulness and variety of their details. The published account is illustrated by numerous engravings, which add greatly to the value of the text. Taking all the conditions of the apparition into account, the geographical position of Poulkova was perhaps the most favorable of any of the stations for viewing the Comet.

The greater part of the sketches and drawings of the Comet used as materials for the engravings were made at the Observatory of Harvard College. With the exception of the wood-cuts, the engravings have been executed by Mr. James W. Watts, of Boston; no part of the work is more essential to an exact and intelligible history of the Comet, and certainly none stands so little in need of commendation. The style of engraving adopted for the steel plates, to give positive effects upon a dark ground, is seldom called into requisition excepting for the delineation of astronomical objects, and it is consequently almost a distinct branch of art. In ordinary drawing, it is often allowable to produce effects at the sacrifice of precision in the details, but no such device is admissible here. The delicate shadings by which the misty outlines of the envelopes and other features of the Comet are expressed, must be conveyed without prejudice to correctness in form and dimensions, otherwise the scientific value of the representation is entirely lost. Again, the utmost range of light and shade in the engraving is limited by the whiteness of the paper and the blackness of the ground, whereas

the actual contrast to be imitated, from the star-like brilliancy of the nucleus to the faint haze of the external boundary of light, scarcely distinguishable from the dark background of the sky, is indefinitely greater; very nice attention must therefore be given to the graduation of the lights, so as to include all the variations possible in their proper order. The responsibility thus thrown upon the artist can scarcely be met by mere professional skill; he must feel some degree of sympathy with his subject, and enter into its general spirit and design. When the many obstacles to success are considered, it will hardly be a matter of surprise that this method of description has been resorted to in but comparatively few instances, and has been so seldom successful. Still, it should be a strong incentive to its wider application, to remember that our knowledge of some of the most interesting of celestial objects cannot be effectually advanced in any other way. This is emphatically true with reference to comets. The original record of their aspect cannot be stated in numbers, nor by measurement alone, nor can it be adequately described in words; to neglect, therefore, the natural expression for all the details of their configuration, is to abandon almost the only suitable means by which the phenomena of their physical constitution can be investigated with any chance of success.

It remains to add a few words with reference to the source from which the means of publishing this volume have been derived. The cost of the letter-press, with other incidental expenses of publication, has been assumed by the venerable Josiah Quincy, through whose liberality the previous volumes of the Annals of the Observatory have been issued. The expense of the engravings has been shared by a few private individuals of Boston and its vicinity. A list of their names, scarcely any of which now appear for the first time as benefactors to the Observatory, will be found preceding the Introduction.

To one of the number, J. Ingersoll Bowditch, Esq., my thanks are especially due on this occasion. Without the assurance of his kindly interest and encouragement, the design of the work in its present extent would not have been entertained; and it is mainly through his energetic support in a time of political and financial agitation peculiarly unfavorable to such an enterprise, that I have been able to carry out, in every particular, the original plan of publication.

G. P. BOND.

Observatory of Harvard College,
June, 1862.

THE GREAT COMET OF 1858.

I. FIGURE AND POSITION OF THE TAIL.

Following the plan proposed in the Introduction to the present volume, the observations relating to the figure, dimensions, and position of the tail, for the most part as it appeared to the naked eye or with telescopes of low power, will be here collected under one view, and arranged in the order of their dates, and, under the same dates, in the alphabetical order of the names of the observers. With the exception of occasional remarks, introduced usually with a view to direct the attention of the reader to points of special interest, the collection will be made up of quotations taken, *verbatim*, from the original publications. The references to the latter are cited with sufficient fulness to admit of easy verification or comparison with the context, if desired.

The discussion of the observations will form the subject of a distinct section.

The earliest notice of the appearance of the tail occurs on the 14th of August, seventy-three days after the discovery of the Comet. It was seen at Copenhagen by D'Arrest, and at Vienna by Hornstein [?] * on this day.

1858. August 14.

Copenhagen. D'Arrest. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 208.)

"Kometen viste sig i henved 14 Graders Hœide som en Stjerne af 5–6te Stœrrelse, en rund Taageplet, 35″ i Diameter, med et skarpt lysende Midtpunkt; Spor af en Hale paa 3 til 4 Bueminuters Længde i Kometsœgeren."

* As the names of the observers are not attached to the remarks on the physical constitution of the Comet, published in the Annals of the Vienna Observatory, they have been supplied from the observations on the position of the nucleus of the same dates, found in another part of the volume.

VIENNA. HORNSTEIN [?]. (*Annalen der k. k. Sternwarte in Wien*, F. III. IX. p. 177.)

"Am 14 August war der Comet schon sehr hell, und trotz seines tiefen Standes und des störenden Mondscheins, ein Schweif von nahe $\frac{1}{6}$ Grad Länge zu erkennen."

The form in which the tail first issued from the head was particularly noticed at the Observatory of Harvard College, where it was seen on the 20th. It was at its origin, of even breadth with the head, not projected from it, as is often the case, in a compressed bright ray much narrower than the nebulous mass from which it originated.* This, with subsequent observations of similar import, deserves more attention from the fact that we were then viewing the Comet in a direction but slightly inclined to the plane of its orbit. It may be remarked, that the tail was now much reduced, by perspective foreshortening, from its full-length proportions, or as it would have appeared if viewed at right angles to the axis; the presence of a strong twilight in the sky, and its low altitude, also tended to impair its brilliancy.

1858. August 20.

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"Comet low in the twilight, red, concentrated, and fiery, with traces of a tail." A sketch illustrating the figure of the tail near the nucleus accompanied the above remarks.

On the 23d, the tail was still so faint as to be easily overlooked in the moonlight.

1858. August 23.

CAMBRIDGE, ENG. BREEN. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 16.)

"Bright, but no trace of a tail; the sky clear, but the moon nearly at full."

From this time forward, one of the most distinctive features in the appearance of the tail was the strong contrast which obtained between the two branches. The convex side, that which followed the axis in the order of diurnal motion, was by far the brightest and best-defined, each having an aspect perfectly characteristic, and noticeable at the first glance. It is interesting to observe at how early a stage in the development of the tail it assumed this peculiarity. The question whether the bright side maintained an unaltered position relative to the axis, in other words, whether or not it was from the outset on the side of the axis following in right ascension, is deserving of the most careful scrutiny; for

* The great comet of July, 1861, may be referred to as an example of this formation. In its ordinary aspect it presented near the head the appearance of a narrow bright ray, nearly coincident with the axis of the tail, and having a diameter much less than that of the nebulosity from which it issued.

if the plane of greatest expansion of the tail is supposed to coincide throughout its entire extent with that of the orbit, the bright branch must have preceded the axis in orbital motion, and, as seen from the earth, would have preceded in diurnal motion also, before we had reached the line of nodes, or previously to the morning of September 8th. It would have been projected upon the other branch at or near that date, reappearing subsequently on the opposite side of the axis, and these changes of position would cause the comet to assume very different aspects.

The following observations place beyond doubt the very remarkable fact that the order of brightness was unaltered by the nodal passage; consequently the two branches of the tail, if disposed according to the above hypothesis, must have issued from the head in a plane inclined to that of the orbit by an angle not less than that comprised between the plane through the Earth, Sun, and Comet at the time of observation, and the orbit, or about *fifteen* degrees. To have sensibly affected the aspect of the Comet so early as August 24th, when the phenomenon was first recorded by D'Arrest, and when the faintness of the tail would have allowed only a strongly marked contrast to be recognized at all, the inclination must have been much greater. Under these circumstances, our notions of the actual figure of the tail lose something of their assumed simplicity. The initial axis, and possibly the plane of the principal expansion at a large distance from the head, there is reason to suppose, lie in or quite near the orbit plane,* while the initial plane passing through the branches would seem to have a strong inclination to that of the orbit. At the same time, it may be true that what we have called the branches of the tail are only denser streams of nebulosity in the conoid, whose sections *near the head*, by planes perpendicular to the axis, are nearly circular.† Or we may dispense with the idea of a conoidal arrangement altogether, and conceive of the tail simply as composed of a great number of streams of nebulosity, distributed irregularly, but more crowded and dense in some directions than in others.

In this connection, the following memoranda will acquire a new interest. But few precise descriptions of the aspect of the Comet previously to the 12th of September have been published; fortunately, however, we possess, in the observations by D'Arrest, at Copenhagen, the testimony of a most competent astronomer in reference to the question at issue. It may be added, that the Observatory at

* Pape, Astron. Nachrichten, 1173, p. 330. Winnecke, Pulk. Beob. des Grossen Cometen, 1858, pp. 60 – 64.

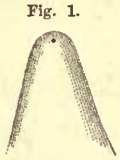
† Winnecke, Pulk. Beob. des Grossen Cometen, 1858, p. 55.

Copenhagen was better situated for viewing the Comet at this time than those in a lower latitude. At Poulkova and Dorpat, both in other respects well placed, the atmosphere was obscured by smoke from the burning of the moors in their neighborhood.

1858. August 24. (Fig. 1.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 209.)

Fig. 1.



"Kjærnen syntes i Aften særdeles skarpt fremtrædende. Halens Længde henved 6 Bueminuter; dens hoeire (oestlige) Rand var noget skarpere begrændset end den venstre forangaaende; overhovedet var der af Halen, formedelst den endnu meget lyse Baggrund, kun Randene synlige."

In confirmation of the text, which states expressly that the side following in right ascension was "much more sharply defined" than the preceding, the figure from which the woodcut (Fig. 1) has been copied shows the branch following in right ascension both longer and more strongly pronounced than the other. On the 31st, the distinction is still more unequivocally expressed by D'Arrest. Its identity with that having a similar aspect subsequent to the Earth's passage from the north side of the orbit, admits of no question. The early recognition of the bifurcation of the tail is also interesting, although, probably, from the faintness of the object, it was overlooked by other observers. Hind, in the passage quoted under the date of August 30, remarks, however, that the tail was thrown off without bifurcation; and Williamson, that "the tail was comparatively narrow at first (Sept. 7th to 12th), with the greatest brightness at the centre and not at the sides."* This statement it is difficult to reconcile with other accounts.

On the 29th, a tail of 2° in length was seen at the Observatory of Harvard College with the aid of the Comet-seeker.

1858. August 30.

REGENT'S PARK, LONDON. HIND. (*London Times.*)

"The Comet was just perceptible to the naked eye; its nucleus is strongly condensed and brilliant, and the tail is thrown off in the ordinary form, without bifurcation."

VIENNA. HORNSTEIN [?]. (*Annalen der Wiener Sternwarte*, F. III. IX. p. 177.)

"Um 8^h 34^m m. W. z. erschien die Länge des Schweifes mit dem 6 zölligen Refractor nahe 1 Grad, die Breite 6 bis 10 Minuten; der Kopf hatte nahe 5 Minuten Durchmesser. Auch mit dem Steinheilschen Cometensucher erschien die Länge des Schweifes ungefähr von derselben Ausdehnung. Die Richtung des Schweifes

* Canadian Journal, Vol. III. p. 486.

ging fast genau auf einen Stern der 8 Grösse in Bessels Zone 495, dessen scheinbarer Ort gleich $10^h\ 35^m\ 13^s.12,\ +34°\ 6'\ 15''.9$ gefunden wurde."

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 260.)

"Bei sehr reinem Himmel, Komet sehr hell, bereits mit freiem Auge sichtbar. Die Helligkeit hat sehr stark zugenommen; die Mitte des Kometen ein fast planetenartiges Scheibchen; auch zeigt sich bereits ein fächerartiger Schweif von fast einem halben Grade Länge auf der von der Sonne abgewendeten Seite."

1858. August 31. (Fig. 2.)

Fig. 2.

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, pp. 209, 210.)

"Halen har siden August 24 faaet en meget betydelig Udvikling; dens hœire Rand (i Kikkerten) viser sig skarpt begrændset, hvorimod den venstre udvaskede Rand ikke frembyder nogen bestemt Contour. Kometen var paa hiin Aften godt af tredie eller fjerde Stœrrelse, men paa den lyse Himmelgrund begyndte den fœrst nu at vise sig for det blotte Œie."

The description of the well-defined character of the contour of the right-hand branch (as seen in the inverting telescope), and the indistinctness of the other, answers precisely to its aspect when viewed some weeks later from the opposite side of the orbit plane, and deserves attention in connection with the remarks which follow respecting the direction of the curvature of the tail on September 2d and subsequently.

1858. September 1.

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 260.)

"Mit einem *Fraunhofer*'schen Kometen-sucher, maass ich den Schweif zu einem halben Grad Länge."

The following passage contains the first notice of the curvature of the tail:—

1858. September 2. (Fig. 3.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 210.)

"Paa Fig. III har jeg forsœgt at fremstille Kometens Skikkelse Kl. henimod $8^h\ 50^m$. Indeni Kjærnen, hvis Diameter skjœnnedes $= 10''$, skimtede jeg med den stærkeste Forstœrrelse Noget som lignende en Stjerne af 3–4de Stœrrelse paa neppe mere end 1 eller 2 Buesecunders Diameter. Halen, der nu begyndte at vise en betydelig Bœining, saaes i den *Fraunhofer*'ske Kikkert omtrent 20 Minuter lang; i Kometsœgeren derimod kunde den allerede nu fœlges over halvanden eller maaskee to Grader."

Fig. 3 has been copied from D'Arrest's lithograph. An outline from his drawing

for the 23d of September is also subjoined (Fig. 4) to show that the character of the curve previously and subsequent to the time of the Earth's passage through the plane of the orbit was essentially the same.

Fig. 3.

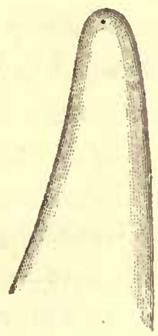
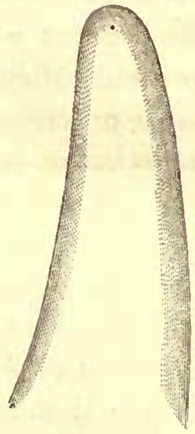


Fig. 4.



The direction of the curvature, which is plainly expressed in the figure for September 2d, is remarkable. We must consider that the Earth's position at this time, and the presentation of the side of the axis occupied by the brighter branch, were such that the latter must have tended in its curve to cross from the north to the south side of the plane of the orbit, if the above figure and description are to be relied upon. Or, if we insist that the plane of curvature is coincident with, or very nearly parallel to, that of the orbit, then the extremity must have been bent in a direction in advance of the line of the radius vector prolonged, and very strongly too, in order to become perceptible when the Earth was so near the node.*

There is unquestionably some allowance to be made for possible errors in the observations, owing to the feebleness and undecided character of the light of the comet; yet it is to be noticed, that this abnormal curvature occurs in close connection with the anomaly in the position relatively to the plane of the orbit of the two branches in which the tail issued from the head. Moreover, the direction of curvature is confirmed by an independent observation, which will presently be referred to under the date of September 5. Towards the close of the apparition, on October 24 and November 7, slight indications appear of a deflection of a similar though less decided character.

* The projections of portions of the orbit with the places of the Sun and Comet given in the Introduction (Plate I., Intr.) may be usefully referred to in connection with the above remarks.

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 260.)

"Bei sehr reinem Himmel Komet sehr lichthell, Kern gut markirt, Schweif $\frac{3}{4}$ Grad lang."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen*, 1858, p. 2.)

"Der Abstand des Kerns vom Südende des Cometen auf 1'.5 geschätzt. Die Breite des Cometen auf dem Parallel des Kerns beträgt 3'.5. Die mittlere Richtung des Schweifs, in wenigen Minuten Abstand vom Kern, wurde gemessen: auf der vorangehenden Seite zu 350°.9, auf der nachfolgenden zu 21°.7. Der Durchmesser des kreisrunden Kerns geschätzt auf 2" – 3"."

"Anmerkung. Eine während der Beobachtung eilig hingeworfene Skizze stimmt mit diesen Angaben sehr gut überein und deutet zugleich darauf hin dass ein dunklerer Zwischenraum in der Mitte des Schweifs schon in 3' Entfernung vom Kern bemerkt wurde."

With regard to the bifurcation of the tail here again mentioned,* subsequent accounts do not entirely harmonize until after the middle of September. Observations like the above, relating to the figure and dimensions of the tail, are particularly valuable at this epoch.

On September 3d, the tail, according to Donati,† was 2° long; on the 4th, it was estimated at 1° 2' by Winnecke.‡

1858. September 5.

OBSERVATORY OF HARVARD COLLEGE. TUTTLE.

16^h m. s. t. A sketch of the tail shows a decided curvature in the same direction as on subsequent dates; i. e. with the convexity on the side following in right ascension. This, it will be again noticed, was previous to the time of the Earth's passing the plane of the orbit, which did not occur until September 8th, and is confirmatory of D'Arrest's observations already quoted.

VIENNA. SCHMIDT. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge = 2°.8
Grösste Breite des Schweifes . . . = 0.5."

1858. September 7.

CAMBRIDGE, ENG. BREEN. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 16.)

"Very conspicuous to the naked eye. Long and broad tail pointed directly north."

1858. September 8. (Plate XXVII.)

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"The Comet was followed this morning in the Great Refractor up to 17^h 21^m m. s. t. (twelve minutes before sunrise). Only the nucleus of 3" diameter, and a

* Compare remarks on August 24.

† Bulletin Obs. Imp. de Paris.

‡ Pulk. Beob. des Grossen Cometen 1858, p. 28.

little nebulosity extending to a diameter of 5″, could barely be distinguished at 17^h 17^m m. s. t. When the Comet was best seen, the nucleus was 8″ in diameter, remarkably intense and star-like, and as bright as a star of the 5th magnitude would appear at the same proximity to the horizon.

"The tail is 4° long in the Comet-seeker, and 2° to the naked eye, to which the Comet appears as a star of the 4th magnitude, with a brush of light. The tail is 2′ or 3′ wide at 3′ from the nucleus. The nebulosity on the side toward the sun is very faint beyond the distance of 1′."

The description and sketch of the Comet are interesting, from their presenting its aspect viewed in the plane of its orbit. A remark appended to the notes of observation on Sept. 12th, shows that on the 8th the Comet was brightest on the side following in right ascension, as on later dates.

HIGHBURY, ENG. BURR. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 26.)

"The tail was quite half a degree long, of a brush-like form."

The telescopic appearance of the Comet on September 8th is represented on Plate XXVII.

1858. September 10.

PARIS. CHACORNAC. (*Bulletin Obs. Imp. de Paris.*)

"La chevelure qui entourait le noyau de la Comète ne présentait rien de remarquable; elle s'étendait uniformément de part et d'autre sans présenter de différences d'éclat nettement accusées; sa lumière faible se confondant graduellement avec le fond sombre du ciel sans présenter de limites tranchées."

VIENNA. HORNSTEIN [?]. (*Annalen der k. k. Sternwarte in Wien*, F. III. IX. p. 177.)

"Schweiflänge 4 Grade; für die Breite desselben und den Durchmesser des Kopfes wurden folgende Schätzungen erhalten:

"Durchmesser des Cometen am Kerne senkrecht auf die Schweifrichtung = 5 Min.
Breite des Schweifes in einem Abstande von 30 Minuten vom Kerne = 15 "
" " " " " " 1 Grad " " = 15 "

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 261.)

"Schweif ist besen-artig, zwei Grade lang, allmalig auf dem dunkelen Himmelsgrunde verwaschen auslaufend."

On the same date, Heis, at Münster, gives 3° for the length of the tail.*

VIENNA. SCHMIDT. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge = 5°.4."

1858. September 11.

DESSAU. SCHWABE. (*Astron. Nachrichten*, 1165, pp. 205 – 207.)

"Der Schweif war weiss, streifig, etwas nach links im astron. Fernr. gekrümmt

* Astron. Nachrichten, 1169, p. 269.

und auf seiner rechten convexen Seite heller; sein Licht war veränderlich, bald heller, bald matter. Von der linken Seite des Kopfes im astr. F. ging ein aüsserst matter, kurzer Nebenschweif aus, der mit der Axe des Hauptschweifes einen Winkel von 45 bis 50 Grad machte, aber schon am andern Tage verschwunden war und nicht wieder sichtbar wurde. Mit 96 m. Vergr. wurde der Kern kleiner, nach der Sonne zu ging ein Lichtstrom aus, dessen haarförmige Streifen sich bogenförmig zurückkrümmten und mit dem Schweife sich vereinigten, oder vielmehr ihn bildeten. Hierdurch trat eine Aehnlichkeit mit dem Halley'schen und Klinkerfues'chen Cometen ein. Mit 144 m. V. war der Kern nur noch ein Punkt, der sich mit 216 m. V. in eine dichte Lichtmasse auflöste."

Collegio Romano. Rosa [?]. (*Mem. dell' Osserv. del Collegio Romano*, 1859, p. 13.)

"La cometa era già visibile ad occhio nudo e la coda era quale si vede nella fig. 2ª senza che però appaia in essa nessuna irregolarità della parte del Sole, e solo il nucleo trovavasi notabilmente eccentrico, l'angolo di posizione della coda 4° 42′ circa."

The figure referred to does not exhibit an excess of brightness on either side, nor a division into two branches.

1858. September 12.

Highbury, Eng. Burr. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 26.)

"The Comet had wonderfully increased in brilliancy. The nucleus was more planetary and discoid in character, of a golden tint, and having the coma, or nebulous haze, extending round it on one side, and stretching away to a tail of about 3° of length in the opposite direction. There was a well-marked, comparatively dark separation between the nucleus and the exterior outline of the head; and the sides of the tail were more brilliant than the central portions, conveying the impression that the bright nucleus was near the extremity of a nebulous tubular envelope with slightly divergent sides, and therefore approximating to a funnel shape."

Observatory of Harvard College. G. P. Bond. 7^h to 8^h m. s. t.

The tail could be traced this evening with the Comet-seeker over an arc of 6°. To the naked eye its length was 4°. At 15^h 30^m it was seen by Mr. Hall 5° or 6° long with the naked eye; the side following in right ascension was the brightest. A similar appearance was noticed on the 8th.

Haddenham, Eng. Dawes. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 88.)

"Sky remarkably clear, Comet found with the Equatorial at 6^h 43^m Gr. m. t., and was at that time well and easily seen. At 8^h 32^m the visible length of the

tail was 3° 30′, a fine object to the naked eye. In the telescope the nucleus appears quite planetary. Long after the head had set, the tail was visible, rising obliquely from the horizon, and might have been seen all night but for the intervention of trees in the northern horizon. The comet was a beautiful object in the northeast at 15^h."

Regent's Park, London. Hind. (*London Times*, Sept. 13.)

"From 3 to 4 o'clock this morning, the sky being remarkably clear, the Comet of Donati presented itself as a very conspicuous object in the northeastern heavens. Its nucleus was as bright as a star of the second magnitude, and, though not planetary in appearance, bore high magnifiers better than any comet I remember to have seen. The tail, which might be traced in the 'Comet-seeker,' about five degrees from the head, consisted of a single ray, very well defined on the side preceding with reference to the direction of motion, but fading away indistinctly on the opposite side. A very faint ray of light emanated from the nucleus towards the sun, as previously remarked in several of these objects, and I thought at moments that a short 'horn' or 'sector' issued therefrom at right angles to the axis of the tail."

Bradstones near Liverpool. Lassell. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 21.)

"From 8 to 9 P. M. The Comet was first viewed with the 20-foot equatorial, with a power of 155, having a field of 19′.1 in diameter.

"Nucleus estimated to be 10″ diameter, remarkably well defined. Its appearance reminded me of the disk of the planet Uranus in this telescope with a power of 400 when the atmosphere was unfavorable enough to make the edge of the disk soft. A slight bifurcation was suspected at about 10′ from the nucleus, but was not fully ascertained. Breadth of the tail about 12′. Edge of the tail on the side towards which the Comet was advancing obviously brighter than the opposite edge.

"The Comet was also viewed with a refractor of 2.6 inches aperture, and power 35 with a field of 76′. The tail was about twice the diameter of the field in length, or 2½ degrees. The tail seemed narrower in proportion than in the 20-foot, but that might arise from the small portion of the tail visible at one time in the latter instrument. The substance of the tail appeared streaky in the direction of its length. It was almost exactly parallel from within a very short distance of the head, and had a slight curvature, the convex side being that which, speaking relatively to the Comet's motion, was the preceding side. The nucleus, in this telescope, seemed bright, but rather stellar than planetary.

"Owing to the general cloudiness of the sky here, I did not see this Comet at

all until the evening of the 11th September, and then only for a short time between clouds, too short to allow of placing the large telescope upon it."

In manuscript notes accompanied by a pencil sketch communicated by Mr. Lassell, it is stated that the point at which the breadth of the tail was measured was 20′ from the nucleus, and that the edge of the tail on the brightest side was much better defined than on the other. The sketch accords very well with Plate XXVII.

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 2.)

"Der Himmel leicht bewölkt, aber der Schweif konnte doch durch zwei Durchmesser des Suchers verfolgt werden. Aus Ablesungen am Declinationskreise wurde seine Länge 2°.5 gefunden. Der Schweif auf der vorangehenden Seite ein wenig concav ausgebogen und weniger scharf begränzt als auf der nachfolgenden. . . . . . Abstand des Kerns von der südlichen Begränzung der Nebelmasse zu ein Viertel Feld von Vergr. III, oder zu 1′.7 geschätzt. Auf dem Parallel des Kerns, Breite der Nebelmasse = 0.6 Feld von Vergr. III, oder 4′.0."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 21, 28.)

"Scheitelradius der Coma 1′.7. . . . .

"Fürs blosse Auge erstreckt sich der Schweif bis auf $\frac{2}{5}$ der Entfernung des Cometen von ψ Ursæ Maj. und seine Richtung geht knapp $\frac{3}{4}$° links von diesem Sterne vorbei; daraus Länge = 3°.8, $p = 354°$. Im Sucher des Heliometer konnte ich ihn durch 1.6 Felder verfolgen, also Länge 3°.0.

"Gegen Morgen betrachtete ich den Schweif im Cometensucher. Er reicht darin durch das ganze Gesichtsfeld, aber auch nicht weiter, woraus sich die Länge zu 3°.2 ergiebt. Seine Helligkeit scheint mir in der Richtung senkrecht auf die Längenaxe allenthalben genau gleich zu sein; wenn ein Unterschied da ist, so ist die Mitte heller. An beiden Seiten des Schweifes ist ein schmaler, sehr schwacher Lichtstreif."

In reference to the division of the tail at this epoch into two branches, the following remarks of Winnecke explain an apparent discrepancy between his observations of the 12th and the general tenor of the testimony on this point.

"In den ersten Tagen meiner Beobachtungen habe ich über die Vertheilung der Helligkeit im Schweife keine Aufzeichnungen gemacht, wahrscheinlich weil sich nichts Auffallendes in dieser Beziehung zeigte. Erst am 12 Sept. findet sich die Bemerkung, dass der Schweif im Cometensucher in der Richtung senkrecht auf die Längenaxe überall gleich hell sei, vielleicht sogar in der Mitte heller als an den Seiten. Es ist diese Bemerkung in entschiedenem Widerspruche mit den Angaben einiger englischen Beobachter für denselben Tag, deren einer (Breen)

den Schweif 'considerably fainter near the axis than at the sides' nennt, der andere (Burr) sagt; 'the sides of the tail were more brilliant than the central portions.' Ich erkläre mir diese Verschiedenheit daraus, dass meine Angabe für Sept. 12 sich auf weiter vom Kopfe entfernt liegende Theile des Schweifes bezieht, als die der erwähnten Beobachter; denn auch später, als die Verschiedenheit des Lichtes sehr gross ward, wären die Nüancirungen in grösseren Entfernungen vom Kopfe nicht so scharf ausgesprochen. Jedenfalls kann man hiernach annehmen, dass an diesem Tage der Unterschied der Helligkeit an den Rändern und in der Axe noch nicht sehr bedeutend war. Am 16 September hatte sich das schon geändert. Die vorhergehende Seite war beträchtlich schwächer, als die nachfolgende." *

For nearly two weeks the light of the moon now interfered with the visibility of the Comet, and prevented the expansion of the tail from being fully recognized.

1858. September 13.

CAMBRIDGE, ENG. BREEN. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 16.)

"The tail slightly curved and pointing nearly north."

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, p. 310.)

"Die kernartige Verdichtung schien mir nichts Auffälliges zu zeigen, sie war nach allen Seiten von einer hellen Coma umgeben, die nach der, der Sonne entgegengesetzten, Seite in den Schweif überging. Letzterer war fast gerade und im Cometensucher etwa 4° lang; jedoch war die vorangehende Seite ein wenig gekrümmt, indem die Convexität der Krümmung der Richtung zugekehrt war, wohin der Comet sich bewegte. Dieselbe Seite war etwas heller und schärfer begrenzt als die gegenüberliegende."

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 262.)

"Maas ich den Schweif zu 2° 20′ lang."

VIENNA. SCHMIDT. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge, 6°.0."

1858. September 14.

PARIS. CHACORNAC. (*Bulletin Obs. Imp. de Paris.*)

"La portion sud de la chevelure continue d'être plus brillante que celle nord."

MARKREE. COOPER AND GRAHAM. (*Obs. Donati's Comet* 1858, *Markree*, p. 6.)

"Tail about five degrees long. A small star was visible through the axis of the tail, half a degree from the nucleus."

* Pulk. Beob. des Grossen Cometen 1858, p. 55.

VIENNA. WEISS [?]. (*Annalen der k. k. Sternwarte in Wien*, F. III. IX. pp. 177, 178.)

"Der östliche Rand des Schweifes erschien viel schärfer begrenzt als der westliche; der Schweif war gekrümmt, die convexe Seite der Richtung der Bewegung des Cometen zugewendet."

1858. September 15.

BERLIN. BRUHNS. (*Astron. Nachrichten*, 1205, p. 73.)

"Der Schweif wurde 6° lang geschätzt."

BERLIN. FÖRSTER. (*Astron. Nachrichten*, 1205, p. 67.)

"Schweif über 5° Länge."

FLORENCE. DONATI. (*Bulletin Obs. Imp. de Paris.*)

"Après la mi-Septembre, la queue commença à se montrer partagée en deux, suivant sa longueur. Les deux bandes lumineuses étaient d'inégale épaisseur, et la partie sombre qui les séparait, très-foncée près du noyau, s'éclairait peu-à-peu en s'en éloignant, et finissait par se confondre avec les parties les plus eloignées, et les moins eclairées de bandes claires. Cette division de la queue n'est plus visible à présent."

1858. September 16. (Plates I., XXIV., and XXV.)

CAMBRIDGE, ENG. BREEN. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 16.)

"The tail curved to the preceding direction and nearly north."

BERLIN. BRUHNS. (*Astron. Nachrichten*, 1205, p. 73.)

"Schweif 7° lang geschätzt."

DORPAT. MÄDLER. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. pp. 35, 36.)

"Der ziemlich gut begrenzte Schweif 6–8° lang. . . . . . Der Schweif umgiebt den Kern mit parabolischer Krümmung, und seine Begrenzung um den Apex herum erscheint ganz scharf. Seine verlängerte Richtung trifft beiläufig auf β Ursæ Majoris."

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 261.)

"Komet in den Morgenstunden, weil höher stehend als am Abende, viel heller; der Schweif misst nahe 4° und ist säbel-förmig sanft gebogen; die convexe Seite der Krümmung ist am Abend gegen Westen gewendet."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 21–29.)

"Das Aussehn des Schweifes und der Coma hat sich nicht unwesentlich verändert. Während früher keine irgend erhebliche Lichtansammlung stattfand, ist heute die folgende Seite des Kopfes bedeutend heller, als die vorhergehende. Der Kern ist umgeben von einer sehr hellen Nebelmasse, die in der dem Schweife entgegengesetzten Richtung sich auf etwa 40″ vom Kerne entfernt, dann umbiegt und den eigentlichen Schweif bildet. . . . . .

"Im Durchschnitte des Kernes ist die helle Nebelmasse 1′.5 breit, die schwache aber gegen 4′.

"Die Vertheilung der Helligkeit im Schweife hat sich wesentlich verändert; die nachfolgende Seite desselben ist beträchtlich heller, als die vorgehende. Die letztere zeigt sich auch im Cometensucher bei grösserer Entfernung vom Kopfe weniger scharf begränzt, als die erstere. Eigenthümlich ist, dass die freilich sehr vage Trennungslinie der hellern Materie von der schwachern nicht in der Axe des Schweifes liegt sondern schräg hindurch geht und ein spitz zulaufendes, gleichsam keulenförmiges, helleres Stück aus dem Schweife absondert, dessen Länge 0.7 des Cometensucherfeldes = 2°.2 beträgt, während die schwächern Theile sich fächerförmig ausbreiten und wohl noch 0.8 Feld = 2°.5 weiter zu verfolgen sind.

"Länge des Schweifes im Sucher des Heliom. = 1.95 Feld = 3°.7, im Cometensucher = 4°.9, fürs blosse Auge 5° 5.

"Breite des Schweifes nach Schätzung im Heliometer:

Abstand vom Kopfe.	Breite des Schweifes.	Breite der schwächern Umhüllung.
5′	7′.0	8′.3
13′	9′.5	10′.3
26′	14′.0	?

"In 26′ Abstand war die schwächere Umhüllung nicht mehr sicher von der hellern Nebelmasse zu unterscheiden."

A chart of the position of the tail among the stars accompanies the above, and affords the earliest precise data for ascertaining the amount of its curvature.

The appearance of the Comet to the naked eye on September 16th is represented on Plate I.; the outlines of the tail, on Plates XXIV. and XXV.

1858. September 17. (Plates II., XXIV., and XXV.)

Cambridge, Eng. Breen. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 16.)

"The tail is now slightly curved towards the east. A sketch exhibited the curvature and an excess of brightness on the convex side."

Observatory of Harvard College. G. P. Bond.

"Sky quite clear, with the Moon, ten days old, in the S. S. E. To the naked eye the head appears as a star of the 2d magnitude; the tail near it is brilliant for a distance of 1°. It can now, owing to the moonlight, be traced with certainty only 4°. The south-following side of envelope and tail is evidently the brightest. The curvature is recognized with certainty."

A sketch was added, showing the bifurcation and amount of curvature.

COMET OF DONATI 1858.

SEPTEMBER 17TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE.__PLATE II.

G.P. Bond Del. J.W. Watts Sc.

COMET OF DONATI 1858.

SEPTEMBER 16TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE.__PLATE I.

Printed by Chas. D. Andrews

VIENNA. SCHMIDT. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge 6°0."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 2.)

"Abstand des Kerns von der Spitze des Nebels kaum 0′.5, aber ein schwächerer Nebeldunst, etwas länglich in der dem Schweif entgegengesetzten Richtung, bis auf ·3′ Abstand vom Kern erkannt. Letzteres war schon von mir am Abend vorher an einem dreifüssigen Münchener Fernrohr bemerkt. Der Schweif auf der vorangehenden Seite viel schwächer und unbestimmter als auf der nachfolgenden; in der Mitte zwischen den beiden Schweifhälften entschieden dunklerer Zwischenraum, der nur mit schwacher Nebelmasse gefüllt zu sein scheint."

The following is the earliest notice of the appearance of the faint secondary tail.

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 29.)

"Im Cometensucher ist der Schweif wohl einen Grad weiter als gestern zu verfolgen, wie sich aus seiner Lage gegen die ihn Tags vorher begränzenden Sterne ergiebt. Ich bemerke aber noch einen sehr schwachen Ausläufer, der vier Grad weiter geht, und in der Richtung des hellern Theils des Schweifes liegt, von ihm aber durch einen dunklen Raum von 20′ Länge getrennt. Dieser neue schwache Schweif endigt einen Grad links (im Fernrohre) von 59 Ursæ Maj. Etwa ebensoweit lassen sich auch die äussersten Schweifspuren mit blossem Auge verfolgen. Positionswinkel des Nebenschweifes hiernach 350° ±, Länge 8°."*

KINGSTON. CANADA WEST. WILLIAMSON. (*Canadian Journal,* III. p. 486.)

"Tail of about 5° in length, pointing between χ and ψ (Ursæ Majoris), but nearer to the latter."

The appearance of the Comet to the naked eye on September 17th is represented on Plate II.; the outlines of the tail, on Plates XXIV. and XXV.

1858. September 18. (Plates XXIV. and XXV.)

MARKREE. COOPER AND GRAHAM. (*Obs. of Donati's Comet* 1858, *Markree,* p. 6.)

"Light of Comet much stronger on the east or following side."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 3.)

"Abstand Kern bis Spitze des Cometen . . 25″.

* A secondary tail was seen by Schwabe (*Astron. Nachrichten,* 1165, p. 206) as early as September 11th, but it was not afterwards recognized, and from its position was probably distinct from that above mentioned. The observation reported by Mr. Hind, September 12, may possibly refer to the ray mentioned by Schwabe.

"Breite der Nebelmasse auf dem Parallel des Kerns $= 1'.5$

" " " bei 4′ Abstand vom Kern $= 3.0$

"In der Entfernung einer Minute vom Kern beginnt die Theilung des Schweifs."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 29.)

"Die Farbe des hellen Schweifes ist gelblich." A chart of the position of the tail among the stars is added.

The outlines of the tail on September 18th are given on Plates XXIV. and XXV.

1858. September 19. (Plates XXIV. and XXV.)

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 22.)

"Der Raum in der Mitte zwischen den beiden Schweifästen in heller Dämmerung sehr schwach." Two charts of the position of the tail among the stars are added.

The outlines of the tail on September 19th are represented on Plates XXIV. and XXV. The figures of the tail from September 16th to September 19th inclusive, drawn on Plate XXV., have been derived principally from the Poulkova charts.

1858. September 20. (Plate XXVIII.)

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

The tail was plainly bifurcated, and the branch following in right ascension "was so much the more brilliant of the two, that in strong twilight this alone would have been seen as a short tail, inclined by 30° or more to the true axis."

MARKREE. COOPER AND GRAHAM. (*Obs. of Donati's Comet* 1858, *Markree*, p. 7.)

"The light of the tail was pretty uniform throughout the entire breadth for about twice the diameter of the nucleus, northward; thence it parted into two rays, the upper one (N. E.) being the brighter and broader. The tail was directed precisely to χ Urs. Maj., and was six degrees long at least; but the strong moonlight probably obliterated the fainter portion."

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, p. 311.)

"Der Schweif des Cometen, den ich bei hellem Mondschein nicht über 4° weit verfolgen konnte, war stärker in demselben Sinne gekrümmt, wie am 13ten Septbr., seine Erscheinung im übrigen ähnlich der an jenem Tage beobachteten."

The telescopic appearance of the tail in the neighborhood of the nucleus is presented in Plate XXVIII.

1858. September 21.

CAMBRIDGE, ENG. BREEN. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 16.)

"The tail about 5° in length."

HIGHBURY, ENG. BURR. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 26.)

"The light of the head exceeded that of any star in Ursa Major, and closely approached that of Procyon; while the tail was 8° long, and curved like a scymitar, a characteristic which it preserved during the remainder of its appearance."

MARKREE. COOPER AND GRAHAM. (*Obs. of Donati's Comet* 1858, *Markree*, p. 7.)

"The tail is directed, almost precisely, to Polaris. Moonlight greatly diminished the effect, and took from the apparent length of the tail."

DORPAT. MÄDLER. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. p. 38.)

"Auf der Nordseite des Kopfs ein dunkler Raum, so dass zwei Schweiftheile entstehen, die aber bald zusammenfliessen."

ALTONA. PAPE. (*Astron. Nachrichten*, 1160, p. 128.)

"Der Schweif war (im astr. Fernr.) an der rechten Seite so erheblich heller als links, dass in der Dämmerung zuerst *nur* die rechte Seite sichtbar war. Auch war an diesem Abend die Theilung des Schweifes in zwei parallele Aeste besonders auffällig."

1858. September 22.

MÜNSTER. HEIS. (*Astron. Nachrichten*, 1169, p. 269.)

"Schweiflänge 3° (Mondschein)."

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, p. 311.)

"Es war nun ersichtlich, dass die vom Kern nach dem Scheitel der Coma ausströmende Materie, nach beiden Seiten abbiegend, den Schweif in Gestalt von zwei getrennten Aesten bildete und zwar war der (im umkehrenden Fernrohr) rechte, also vorangehende Ast bei weitem breiter und heller als der linke. Es trat dieser Unterschied noch auffälliger hervor, als bei einbrechender Dunkelheit auch die schwächern Theile des Schweifes sichtbar wurden. Die Axe des Schweifes war durch eine dunkle Zone bezeichnet, die beide Aeste trennte jedoch in grösserer Entfernung vom Kern sich allmälig verlor. Diese Theilung des Schweifes war zwar Septbr. 20 und 21 dadurch angedeutet, dass am Kern, nach der Schweifaxe zu, eine dunkle Zone lag, jedoch war die Erscheinung nicht so auffällig als heute."

VIENNA. SCHMIDT. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge 5°.0."

1858. September 23. (Plate XXIX. and Fig. 4.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 213.)

"Halens Œstrand, som sædvanlig ganske iœinefaldende skarp, i stik Modsætning til det svage, blide og udvaskede Omrids af den venstre vestlige Rand."

Fig. 4 has been copied from the lithograph accompanying the above.

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"A fine clear sky, with the Moon nearly full. To the naked eye the head of the Comet is as bright as a star of the first magnitude, and the train, notwithstanding the moonlight, may be traced 5° or 6°, and at times 2° or 3° farther. It is already a brilliant object half an hour after sunset."

Plate XXIX. shows the telescopic appearance near the nucleus.

DORPAT. LAIS. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. p. 57.)

"Vom Kerne ausgehen 2 sehr bestimmte Lichtstreifen in parabolischer Krümmung in den Schweif über, von diesen ist der rechte Zweig viel heller und verliert sich erst später in dem matten Lichtnebel des Schweifes; zwischen beiden aber zeigte sich sehr bestimmt ein dunkler Streif von etwa $\frac{1}{2}$° Länge. Die Richtung des Schweifs macht auf $\frac{1}{3}$ seiner Länge, die bei hellem Mondschein c. 10° betragen mochte, einen Knie, von welchem an den frühern Tagen nichts zu erkennen war."

The appearance of the Comet in the telescope is represented on Plate XXIX.

1858. September 24. (Plates III., XXVI. Section I., and XXX.)

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"The tail is 7° long in bright moonlight. A tangent to the convex edge near the nucleus prolonged would pass through δ Ursæ Majoris, but the prolongation of the curve of the same edge would pass through γ. This side is brightest to the naked eye." A sketch of the figure of the tail near the nucleus is added.

CAMBRIDGE, ENG. BREEN. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 17.)

"The coma . . . . . in the direction of the tail was considerably fainter nearer the axis than at the sides."

HADDENHAM, ENG. DAWES. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. pp. 88, 89.)

"The narrow dark channel extending from the nucleus up the axis of the tail is very remarkable; its edges are surprisingly well defined, especially very near the nucleus. The comparatively sharp definition of the eastern edge of the tail contrasts strikingly with the softness of outline on the western side. . . . . . A soft nebulosity or coma surrounds the larger arc, and appears to be concentric with it. Its outline is certainly not continuous with that of the tail, the apex of which falls *within* the arc of the sector."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 4.)

"Richtung der Tangente:

COMET OF DONATI 1858.

SEPTEMBER 24TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE_PLATE III

G.P.Bond Del. J.W.Watts Sc.

COMET OF DONATI 1858.

SEPTEMBER 26TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE_PLATE IV

Printed by Chas. D. Andrews

Auf dem Parallel des Kerns, vorangehend		330°
" " " "	nachfolgend	39°
In 2′ Abstand vom Kern, vorangehend		340°
" " " "	nachfolgend	29°
In 6′ Abstand vom Kern, vorangehend		348°
" " " "	nachfolgend	14°
Breite des Schweifs bei 2′ Abstand, ungefähr		2′.5
" " " 6′ " "		5′.

"Die Theilung des Schweifs fängt erst an bei 2 bis 3 Minuten Abstand vom Kern.

"Anmerkung. Ueber die äussere Begränzung des Cometen in der Nachbarschaft des Kerns, wurden um 19^h 15^m einige Schätzungen angestellt. Später ergab sich dass damals noch die Dämmerung zu stark gewesen war, so dass ich theilweise den hellen Halbbogen für die Begränzung angesehen hatte. Am folgenden Tage ergänzte ich aus der Erinnerung: Abstand der äusseren Gränze des Cometen im Parallel des Kerns auf der vorangehenden Seite 35″, auf der nachfolgenden 50″, und diese Angaben, für deren Genauigkeit ich nicht einstehen kann, sind in der Zeichnung II benutzt worden."

Tretire, Hereford. Webb. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 23.)

"The two streams which formed the tail were for a long time unequal in breadth, but were never observed to change sides so as to indicate rotation; the antecedent branch showed greater fulness and density near its origin, even with the small object-glass, on September 24."

Kingston, Canada West. Williamson. (*Canadian Journal*, III. p. 486.)

"Tail had increased to 8° in length."

The appearance of the Comet to the naked eye on September 24 is represented on Plate III. The outlines of the tail on Plate XXVI. Section I., and the telescopic view on Plate XXX.

1858. September 25. (Plates XXVI. Section I., and XXXI.)

Observatory of Harvard College. G. P. Bond.

"At the rising of the Moon the tail reached a little more than half-way from the nucleus to γ Ursæ Majoris; this would make it 10° 30′ long; strongly curved and 1° broad at its extremity, where it is seen only by glimpses. The diffused light on the side of the nucleus towards the sun can be seen scarcely 3′.

"The tail is 5′ to 6′ broad at 12′ from the nucleus. The axis is dark."

Berlin. Bruhns. (*Astron. Nachrichten*, 1205, p. 73.)

"Der Schweif wurde 9° lang geschätzt bei Mondschein: er war stark gekrümmt und durch die Mitte zog sich ein schwarzer Streifen."

BERLIN. FÖRSTER. (*Astron. Nachrichten*, 1205, p. 68.)

"Schweif 10° lang."

SACRAMENTO, CALIFORNIA. LOGAN. (*Astron. Journal*, No. 119, p. 183.)

"Tail estimated at 8° or 9° in length."

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 261.)

"Schweif, bei 10 Grad lang, erscheint merklicher gekrümmt, und ist auf der convexen (am Abend gegen West gekehrten) Seite heller und schärfer begrenzt als auf der concaven Seite."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 30.)

"Der Schweif ist in der Mitte viel dunkler als an den Seiten; diese verlaufen allmälig in den Himmelsgrund. Im Heliometer wird geschätzt: —

5′	Abstand vom Kopfe,	Breite	des	Schweifes		6′.3
10′	"	"	"	"	"	8′.
26′	"	"	"	"	"	11′.7 "

The telescopic appearance of the Comet on September 25 is represented on Plate XXXI. The outlines of the tail on Plate XXVI. Section I.

1858. September 26. (Plates IV. and XXVI. Section I.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 214.)

"Kometens tydelig bœiede Hale saaes forresten i en Fraunhofersk Kometsœger henved syv grader lang."

OPORTO, PORTUGAL. BARON DE FORRESTER. (*Copy communicated.*)

Sketch of the appearance of the Comet to the naked eye, with the stars in the vicinity.

SACRAMENTO, CALIFORNIA. LOGAN. (*Astron. Journal*, No. 119, p. 183.)

"Tail from 10° to 11° long."

HAVANA. POEY. (*Comptes Rendus*, XLVIII. pp. 726, 727.)

"Le 26 Septembre, à 7 heures du soir, sa position, relativement aux étoiles, se trouvait être du nord au sud, la tête près de la Chevelure de Bérénice, et la queue terminant au Cœur de Charles II., mais sans le dépasser. Ainsi toute la comète était dans le prolongement d'une ligne presque droite passant par la Polaire et ε de la Grande Ourse. . . . . . La queue pouvait avoir à l'œil nu 10 degrés de longueur."

VIENNA. SCHMIDT. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge 9°.8."

KINGSTON, CANADA WEST. WILLIAMSON. (*Canadian Journal*, III. p. 486.)

"On the 26th, it was a little south of Cor Caroli, with a tail of about 10°,

pointing nearly through δ of Ursa Major, to the Pole Star [?], and a little concave towards the Sun." [?]

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 30.)

"Es wurde gegen Morgen klar, bezog sich aber wieder, als ich den Schweif kaum mit Hülfe des Cometensuchers in den Harding'schen Atlas eingetragen hatte. Man kann aus dieser Einzeichnung ableiten:

α ☄ $= 187^\circ\ 38'$ δ ☄ $= +34^\circ\ 8'$

Coordinaten des folgenden Schweifrandes:	$\alpha = 188^\circ\ 2'$	$\delta = +36^\circ\ 0'$
	188 4	38 0
	187 55	40 0
Coordinaten des vorgehenden Schweifrandes:	$\alpha = 187^\circ\ 42'$	$\delta = +36^\circ\ 0'$
	187 14	38 0
	186 56	40 0

Abstand vom Kerne.	Breite des Schweifes.
10′	10′
30′	13′
60′	17′
120′	23′
180′	30′
240′	36′
300′	41′
360′	46′."

The very rapid increase of the length of the tail subsequent to the 26th deserves notice. This was shortly followed by a peculiar deflection of the upper extremity, and a great expansion of nebulous matter on the concave side.

The appearance of the Comet to the naked eye on September 26th is represented on Plate IV., and the outlines of the tail on Plates XXIV. and XXVI. Section I.

1858. September 27. (Plates V., XXIV., XXVI. Section I., and XXXII.)

OBSERVATORY OF HARVARD COLLEGE. W. C. BOND.

"Length of tail to naked eye about 9° or 10°. It is curved, convex towards Cor Caroli, and is much better defined on the side next the star than it is on the concave side."

A sketch of the naked-eye view is added.

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"The narrow dark stripe in the axis of the tail, having its vertex precisely at the nucleus (on the side opposite to the Sun), is a remarkable object. The tail

is seen bright half-way from the nucleus to δ Ursæ Majoris, and may be just traceable one or two degrees farther. Strongly curved, and its upper outline best defined, longest and brightest." A sketch is added.

The straight ray or secondary tail was recognized with the naked eye by R. F. Bond, and a sketch made. Elsewhere it was first seen with the unassisted eye on September 30th by Struve, and on October 5th by Winnecke at Poulkova. As a telescopic object it had been detected at Poulkova on the 17th of September.

Cambridge, Eng. Breen. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 17.)

"The tail is getting broader at the end; it could be traced for $7\frac{1}{2}°$ in the finder."

Cambridge, Eng. Challis. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 18.)

"The right side of the tail was also considerably the brighter; the intermediate part was comparatively dark. A star of mag. 8, seen through this part at the distance of a few minutes from the nucleus, exhibited no unusual phenomena."

Neuchatel. Jeanjaquet. (*Souvenirs de la Comète de* 1858, pp. 7, 8.)

"L'ensemble peut avoir de 10 à 12 degrés de longueur. En général, ceux qui l'observent trouvent que la partie occidentale est beaucoup plus fortement marquée que la partie orientale."

Kremsmünster. Reslhuber. (*Astron. Nachrichten*, 1169, p. 261.)

"Die Zunahme des Kometen an Glanz, Länge des Schweifes, mit jedem Tage auffallender; letzterer misst bei 14 Grade Länge."

For an observation confirmatory of the following, the reader is referred to the notes of D'Arrest, September 29, in the collection of observations upon the secondary tails.

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Collegio Romano*, 1859, p. 13.)

"Nella sera del 27 notai che dalla testa della Cometa partiva come un raggio leggiero e sfumatissimo, lungo circa mezzo grado, e quasi diametralmente opposto alla coda. Sono sicuro che ciò non era illusione dello strumento col quale l' avea già guardata altre volte, ma sempre senza quest' appendice. Esso svanì la sera appresso, e non sò ancora se altri abbia fatto la stessa osservazione, ma non sarei sorpreso, che questa particolarità fosse sfuggita, essendo tal raggio debole più che la luce della metà inferiore della coda, a quindi molto difficile ad essere riconosciuto nei cannocchiali; nè lo vidi io solo ma anche altri che eran meco."

COMET OF DONATI 1858.

SEPTEMBER 27TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE.__ PLATE V.

G. P. Bond Del. J.W. Watts Sc.

COMET OF DONATI 1858.

SEPTEMBER 28TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE.__ PLATE VI.

Printed by Chas D. Andrews

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 30.)

"Im Heliometer:

"Entfernung vom Kerne:			5′	Breite des Schweifes:			6′
"	"	"	10′	"	"	"	8′.5
"	"	"	26′	"	"	"	11′
"	"	"	53′	"	"	"	13′.5

"Die dunkle schmale Zone in der Mitte des Schweifes, in fast dem Himmelsgrunde gleichem Lichte, ist heute sehr auffallend."

WALTON COMMON, ENG. USHERWOOD. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 139.)

A copy from the photograph of the Comet here noticed has been communicated to me by R. C. Carrington, Esq.

The appearance of the Comet to the naked eye on September 27th is represented on Plate V.; the outlines of the tail, on Plate XXVI. Section I.; the secondary tail, on Plates V. and XXIV.; and the telescopic view, on Plate XXXII.

1858. September 28. (Plates VI., XXIV., and XXVI. Section I.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 215.)

"Halen viste sig nu for det blotte Œie henved tretten Grader lang."

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"Sky not quite clear, and it soon after clouded suddenly. Comet increases rapidly. Extremity of tail reaches two thirds of the way from the nucleus to δ Ursæ Majoris. The dark opening in the axis seen with the Comet-seeker occupies about one twelfth of its breadth, and may be traced 1° or 2°."

A sketch which accompanies the above shows the dark opening of the axis nearest to the bright side of the tail; but a note was added subsequently, to the effect that it had always been seen nearest to the faint concave side.

MARKREE. GRAHAM. (*Markree, Obs. of Donati's Comet*, pp. 7, 8.)

"7^h 30^m m. s. t. When first freed from clouds, about half past seven this evening, α [12] Can. Ven. was in the tail, a little to the west of the axis; the tail itself could be traced as far northward of this star as the nucleus was southward. Comparing it with Urs. Maj. the tail appeared about equal in length to the distance from γ to ζ, or somewhat more. The breadth at α [12] Can. Ven. was equal to nearly half the distance between ε and ζ Urs. Maj., and regularly diverged as it proceeded upward. The tail was decidedly curved, and the curvature uniform. The line of the axis, if continued upward, would about bisect the line joining δ and ε Urs. Maj. The divergence of the tail was nearly the same from the nucleus throughout. . . . . .

". . . . . The east side of the tail was, as before, decidedly brighter and

broader than the other, — in fact, it occupied nearly half the breadth of the tail; the west side a quarter; and the other quarter was little else than the pure azure of the sky.

"Between nine and ten o'clock the moon began to get troublesome; the tail had lost much of its distinctness, as well from the diminished altitude as from the increasing moonlight."

An engraving of the naked-eye view of the Comet is included among the plates of the Markree Observations, apparently belonging to September 28th.

NEUCHATEL. JEANJAQUET. (*Souvenirs de la Comète de* 1858, pp. 8, 9.)

"Sa queue a continué de grandir, et sa lumière semble encore plus forte que hier. Une étoile, légèrement voilée, se montre dans le centre de l'appendice, qui peut avoir une longueur de 12 à 15 degrés. Cet appendice est visiblement arqué, mais en examinant attentivement on ne tarde pas à reconnaître que la courbure existe essentiéllement sur une longueur de 1 à 2 degrés à partir du noyau; et le noyau ainsi placé a un peu l'air d'un projectile qui, après avoir décrit une courbe régulière, ferait brusquement une chûte, d'un oiseau au vol qui se baisserait soudain pour saisir une proie. À part cette déclinaison, la queue suit un prolongement assez droit; je serais même disposé à croire qu'elle pourrait bien, du côté opposé au noyau, se terminer moins épanouie qu'on n'est générale-ment enclin à le supposer, qu'elle pourrait bien, en un mot, se terminer arron-die. Dans le réfracteur (grossissement 57 et 80) deux effluves, comme la double source d'un fleuve, semblent couler l'une à gauche, l'autre à droite de la tête de la comète, et se verser réciproquement leurs eaux en s'éloignant lentement l'une de l'autre, triple opération d'où résulte le lit de plus en plus élargi du fleuve; mais l'effluve ouest poursuit une course plus longue que l'effluve est, elle est plus fortement marquée et elle se termine plus nettement; je ne saurais mieux représenter le tout qu'en le comparant à un large coup de pinceau donné d'un trait en blanc sur un fond noir, avec un côté naturellement plus accentué que l'autre."

SACRAMENTO, CALIFORNIA. LOGAN. (*Astron. Journal*, No. 119, p. 183.)

"The tail was 17° or 18° long."

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, p. 313, and 1173, p. 337.)

"Nach unten war der Kern und der Ausströmungs-Sector scharf begrenzt durch eine dunkle Zone von gleichfalls parabolischer Form, deren Grenzen die innern, scharf hervortretenden Umrisse der beiden Schweifäste bildeten. Die Axe dieser parabolischen Zone, allem Anschein nach gleichzeitig die Axe des Schweifes, war noch bezeichnet durch einen innern dunkleren Canal. Diese dunkle Zone war sowohl im Cometensucher, wie mit freiem Auge weit in den Schweif hinauf zu

verfolgen, den sie offenbar der ganzen Länge nach in zwei ungleiche Aeste theilte. . . . . .

"Der Schweif hatte sich seit Septbr. 22 ausserordentlich entwickelt; jedoch war im Allgemeinen seine Erscheinung der frühern ähnlich, nur war die linke Seite weit mehr an ihrem oberen Ende zurückgebogen als früher. Auch der Unterschied der Helligkeit und der Schärfe der Begrenzung war auffallender geworden; die linke Seite trat entschieden heller und schärfer hervor, als die rechte. In den folgenden Tagen blieben sich die eben beschriebenen Erscheinungen ziemlich gleich; um unnöthige Wiederholungen zu vermeiden, werde ich daher nur die auffallendern Veränderungen ausführlich erwähnen. . . . .

"Beobachtete Puncte im vorangehenden Schweifrande:

M. B. Z.	α 1858.0	δ 1858.0	α ☄	δ ☄
Sept. 28.308	193° 21′	+ 39° 5′	192° 17′	+ 32° 24′
28.309	190 13	+ 46 13 "		

The article from which the above is taken contains a lithograph of the aspect of the Comet to the naked eye.

GENEVA. PLANTAMOUR. (*Note sur la Comète de Donati*, p. 11.)

"Le 28 Septembre, la queue longue de 18° à 19° paraissait plus arquée que la veille; la partie centrale semblait moins brillante que les deux bords, le bord orientale étant le plus brillant et le plus tranché des deux. Cette différence s'est maintenue, en devenant plus sensible les jours suivants, jusqu'à la fin de l'apparition; le bord occidental se fondait d'une manière beaucoup plus indistincte et moins tranchée avec le fond du ciel."

VIENNA. SCHMIDT. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge 14°.0 (sehr klar)
Grösste Breite des Schweifes 2°.3 "

The appearance of the Comet to the naked eye on September 28th is represented on Plate VI.; the outlines of the tail, on Plate XXVI. Section I.; and the secondary tail, on Plates VI. and XXIV.

1858. September 29. (Plates VII., XXIV., XXVI. Section I., XXXIII., and Fig. 5.)

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"The outline of the dark axis is 20″ broad at 4′ from the nucleus."

MÜNSTER. HEIS. (*Astron. Nachrichten*, 1169, p. 269.)

"Schweiflänge 16°."

NEUCHATEL. JEANJAQUET. (*Souvenirs de la Comète de* 1858, p. 9.)

"La courbure de la queue, dans la partie haute du météore, me parait mieux marquée que précédemment."

Göttingen. Listing. (*Astron. Nachrichten*, 1167, p. 231.)

"Am 29sten Sept. . . . . . der auf etwa 19 Grad ausgedehnte Schweif. . . . . ."

Dorpat. Mädler. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. p. 42.)

"Die Schweifmaterie erstreckte sich beträchtlich weiter nach der Südseite zu. Der Mitte der Ausstrahlung gegenüber zog ein dunkler schmaler Streif zwischen beiden Seiten des Schweifes wenigstens $\frac{1}{2}$ Grad weit fort. Mit blossem Auge gesehen, ging die Richtung des Schweifendes anfangs zwischen ε und δ des grossen Bären hindurch (doch ε näher), gegen 9 Uhr mittlerer Zeit aber gerade auf ε zu."

Kremsmünster. Reslhuber. (*Astron. Nachrichten*, 1169, p. 262.)

"Der Schweif, bei 20 Grade lang, reicht in der Nacht selbst beim tiefsten Stande des Kometen (10° 40′ unter dem Horizonte) über den Horizont gut sichtbar herauf."

Collegio Romano. Rosa [?]. (*Mem. dell' Osserv. del Collegio Romano*, 1859, p. 13.)

"L' inviluppo esterno del paraboloide nebuloso fu trovato 4′.6."

Poulkova. O. Struve. (*Pulk. Beob. des Grossen Cometen* 1858, p. 5.)

"Der die beiden Schweifhälften trennende dunkle Zwischenraum, beginnt beim Kern selbst und ist scharf begränzt. Seine Breite beträgt im Anfange 12″, die Richtung der vorangehenden Seite wurde gemessen zu 5°.3, die der nachfolgenden Seite zu 10°.8."

Poulkova. Winnecke. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 30, 31.)

"Der fast schwarze Streif in der Mitte des Schweifes, der jetzt erheblich mehr hervortritt, als zu Anfange seiner Erscheinung, war sehr auffallend. Die Richtung desselben fällt nicht völlig mit der des Schweifes zusammen, sondern der Positionswinkel ist etwa 5° kleiner, also $p = 11°$. Seine Dunkelheit wird je näher zum Kopfe, je grösser und unmittelbar am Kerne ist diese Zone nicht viel heller als der umgebende Himmelsraum, wobei jedoch die Wirkungen des Contrastes zu berücksichtigen sein werden. Als es später in der Nacht wieder heiter wurde, trug ich mit Hülfe des Cometensuchers die Lage des Schweifes in die Harding'schen Charten ein. Die nachfolgende Seite des Schweifes erschien im Cometensucher viel besser begränzt als die vorgehende, und heller; der schwarze Streif war auch in diesem Fernrohre sehr auffallend.

"In der Einzeichnung des Cometen ist für Rectasc. ein Fehler begangen, wegen der Leerheit der Harding'schen Charten in dieser Gegend, so dass für Dimensionen in der Nähe des Kopfes nichts Sicheres daraus abzuleiten ist. Für weiter entfernte Punkte ergiebt sich: —

PLATE VII

G.P. Bond Del.

J.W. Watts Sc.

COMET OF DONATI 1858.

SEPTEMBER 29TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE

Printed by Chas D. Andrews

Coordinaten des Schweifrandes:

$\delta = 34°0'$	folgend: $\alpha = 195°\ 2'$		vorgehend: $\alpha = 194°\ 17'$	
36 0	"	195 20	"	194 19
38 0	"	195 30	"	194 16
40 0	"	195 28	"	194 14

Abstand vom Kerne.	Breite des Schweifes.
60′	23′
120′	31′
180′	36′
240′	40′
300′	47′
360′	52′ "

VIENNA. WEISS [?]. (*Annalen der Wiener Sternwarte*, F. III., IX. p. 178.)

"Der Ostrand des Schweifes ging durch f (14) der Jagdhunde, bog sich dann zurück, so dass die Tangente an das Endstück desselben gegen ε des grossen Bären zielte, und endete beiläufig in der Verbindungslinie zwischen η und γ im grossen Bären. Die Länge des Schweifes betrug also 22 bis 23 Grade."

The appearance of the Comet to the naked eye on September 29th is represented on Plate VII.; the outlines of the tail, on Plate XXVI. Section I.; the secondary tail, on Plate XXIV.; and the telescopic view, on Plate XXXIII. The latter is perhaps the most satisfactory of the series of telescopic views.

On the 30th, the day of the perihelion passage, we have a distinct recognition of the somewhat abrupt change of direction or deflection of the tail near its upper extremity, perhaps indicated in some of the observations on the 28th and 29th.* This feature was presented at subsequent dates with greater decision. The outlines on the charts (Plates XXIV. and XXVI.) do not give full expression to the abruptness of the deflection, which is much more apparent in the change of direction of the axis of brightness than of the axis of figure, as shown in the chart of the light axis on October 8th, Plate XXV. The naked-eye views, Plates VIII. to XXIII., give a tolerably correct idea of its character, although in this particular they are not entirely satisfactory, owing to defects in the original drawings.

1858. September 30. (Plates VIII., XXIV., XXVI. Section I., and XXXIV.)

GREENWICH, ENG. AIRY. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 12.)

"Length of the tail equal to the distance from α Ursæ Majoris to a point equidistant from ζ and η Ursæ Majoris. The tail curved; its convexity to the left."

* Altona, September 28th; Neuchatel, 29th.

Observatory of Harvard College. W. C. Bond.

Several sketches of the Comet were made, accompanied by the following memoranda: "7^h 30^m. The train sweeps to near the tail of Ursa Major, between Benetnasch and Mizar, without reaching them, — as far as a vertical through a point half-way between these stars. Its breadth, viewed with an opera-glass of which the field of vision was 5° in diameter, was two or three degrees, — the breadth was two degrees opposite Cor Caroli. Excepting near the nucleus, the light was, throughout, strongest on the upper side. This was particularly noticeable in the twilight, when this side could be traced three or four degrees farther than the other. It is curved all the way from the head, but more suddenly at the extremity, so as to bring the direction below Mizar. At 7^h 35^m, by oblique vision, the light is seen as far as a point five degrees below Alcor."

Cambridge, Eng. Breen. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 17.)

"Dark band sharply defined down the tail; the outer boundary of the tail sharp on the right side, and ill-defined on the opposite side."

Cambridge, Eng. Challis. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 18.)

"The tail appeared to stream both from the arch and from the exterior and interior coma, and the right-hand stream was considerably the brighter. By a drawing of the appearance to the naked eye, the curvature of the tail was now very considerable, the convexity turned southward, the convex side much the brightest, and the extremity of the tail broad and diffused. Its estimated length was 20°."

Carbost, Isle of Skye (Lat. 57° 17′, Long. 6° 23′ W.). Chimno. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 28.)

A copy of the drawing described in the article cited has been communicated to me from the Royal Astronomical Society.

Markree. Cooper and Graham. (*Obs. of Donati's Comet* 1858, *Markree*, pp. 8, 9.)

"The tail is about equal in length to the distance between α and γ Boötis, and a line joining the head with the extremity of the tail is almost precisely parallel to a line joining the stars. If the curved line of the tail were produced, the tail would pass between ε and ζ Urs. Maj., at about one third of the distance from the former. As on the former nights, the continuation, if extended, would pass through the pole. . . . . . Mr. Cooper also remarked that, to the naked eye, the left-hand (following) side of the Comet was much better defined than the other; in fact, that the whole appeared like a quill pen with the feathers stripped from one side, and that the length was equal to the distance from γ to η Urs. Maj. When the nucleus was in the cloud, and consequently the tail more distinct, Mr. Cooper said that the extremity of the axis of the tail was in the apex

[illegible] accompany [illegible] them [illegible] could [illegible] all the [illegible] the direc[illegible] by oblique [illegible] as a po[illegible]

[illegible] p. 17.)

[illegible] boundary of the tail [illegible]

[illegible] p. 18.)

[illegible] from the exterior and [illegible] the brighter. By a [illegible] of the tail was [illegible] the bright- [illegible] length was 20°."

[illegible]

[illegible] communicated to [illegible]

[illegible] precisely [illegible] produced, [illegible] of the distance [illegible] extended, would [illegible] to the naked eye, [illegible] defined than the [illegible] with the feathers stripped [illegible] distance from [illegible] to [illegible] consequently the tail more dis- [illegible] said that the extrem[illegible] of the tail was [illegible] the apex

PLATE VIII

G.P. Bond Del. J.W. Watts Sc.

COMET OF DONATI 1858.

SEPTEMBER 30TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE

Printed by Chas. D. Andrews.

of an isosceles triangle, the base of which is the line joining η and ζ Urs. Maj., and the perpendicular of the triangle was about equal to the base. At a quarter past eight, Mr. Cooper said that the breadth of the tail at the extremity was about double the breadth of what it was at one third of the length from the nucleus, and that the eastern or following side of the tail was longer than the western or preceding. We are all agreed that the curvature of the tail was greater than on the 28th. . . . . . 20 Can. Ven. (B. A. C. 4451) was almost precisely in the axis of the tail. B. A. C. 4433 was also in the tail, but nearer the preceding edge of it."

FLORENCE. DONATI. (*Bulletin Obs. Imp. de Paris.*)

"La queue qui était longue d'environ 25°."

LIVERPOOL. HARTNUP. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 56.)

"20^h m. s. t. Length of tail 26°. Greatest diameter 3° 10′. — The tail was curved towards the north, and broadest at or near the end. It was more luminous and better defined on the convex than on the concave side, and a dark band passed from the nucleus through the centre to the extreme end of the tail. On the 30th September a well-defined conical shadow was visible, the length of which, measured from the nucleus or base of the cone to the apex, was 18′. The length of this shadow on the 4th October was 21′, but the contrast between it and the dark band in the centre of the tail was much less striking than it was on the 30th September. On the 8th October it was rendered invisible by the increased darkness of the band which passed through the centre of the tail. The tail of the Comet was more symmetrical, and the envelope was brighter and better defined, on the 30th September than on any other occasion. . . . . .

"Distance from centre of nucleus to front of coma = 1′ 26″.

"Diameter of coma at right angles to tail, measured through centre of nucleus = 4′ 28″."

MÜNSTER. HEIS. (*Astron. Nachrichten*, 1169, p. 269.)

"7^h m. s. t. Schweiflänge 18°."

NEUCHATEL. JEANJAQUET. (*Souvenirs de la Comète de* 1858, p. 10.)

"Longueur 20 à 25 degrés. Avec sa pointe amincie, sa forme arquée, son intensité la plus forte le long de la partie convexe, sa lumière diminuant graduellement de la tête à l'extremité indefinie de la queue, on dirait un enorme panache blanc."

BRADSTONES, LIVERPOOL. LASSELL. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 79.)

"Arcturus and the Comet were at about the same altitude, and the tail could be traced nearly as far as the nearest bright star (η) of the Great Bear. The sky remained clear for only a short interval, and did not permit any view with either of the equatorials."

OXFORD, ENG. LUFF. (*Cycle of Celestial Objects, continued at the Hartwell Observatory to* 1859, p. 257.)

"Length of tail 22°."

DORPAT. MÄDLER. (*Beob. der Kaiserl. Sternw. Dorpat*, Vol. XV. p. 43.)

"Von diesem dunklen Raume auszog sich eine dunkle Spalte durch die Mitte des Schweifes. Im Verlaufe des Abends wird es an der Westseite des Strahls immer heller und zuletzt der innern Strahlenkrone fast ganz gleich."

VIENNA. SCHMIDT. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge = 22°.0 (sehr klar)."

COLLEGIO ROMANO. SECCHI. (ROSA.) (*Mem. dell' Osserv. del Collegio Romano*, 1859, p. 13.)

"In queste sere si fu che la coda della Cometa cominciò a presentare la sua più bella pompa, e a mostrarsi notabilmente curva e ben decisa dalla parte superiore, e molto sfumata e concava dalla inferiore, talmente che fu paragonata da taluni ad una palma e da altri ad una coda di paradisea. La coda era divisa longitudinalmente in due rami da uno spazio oscuro che nel cannocchiale per piccolo spazio presso al nucleo appariva assolutamente nero, indi veniva leggermente sfumando, ma ad occhio nudo tal divisione non si vedea."

AYLESBURY. SMYTH. (*Cycle of Celestial Objects continued at the Hartwell Observatory to* 1859, p. 94.)

A figure of the Comet in which the deflection of the tail at its extremity is indicated.

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 6–8.)

"Die Richtung der vorangehenden Seite des dunklen Zwischenraums zwischen den beiden Schweifhälften wurde heute gemessen zu 9°.0, die der nachfolgenden Seite zu 17°.3.

"Abstand des Kerns von der Sudspitze des Cometen							45″
"	"	"	äussere Begränzung des Cometen auf dem Parallele des Kerns vorangehend				60″
"	"	"	"	"	"	nachfolgend	80″

"Zur Bestimmung der Dimensionen des Cometen in der Nachbarschaft des Kerns und der anfänglichen Richtung des Schweifs können noch folgende Beobachtungen über die Stellung des Vergleichsterns in der Nebelmasse dienen.

Um	19^h	42^m	12^s	Pulk. Stzt.,	Vergleichstern	am nachfolgenden Rande des Schweifs.		
"		52	10	"	"	"	in der Mitte der nachfolgenden Schweifhälfte.	
"	20	3	58	"	"	"	am nachfolgenden Rande des dunklen Streifen.	
"		10	1	"	"	"	am vorangehenden " " "	
"		29	53	"	"	"	am vorangehenden Rande des Schweifs.	

"Die nachfolgende Begränzung des Schweifs erschien durchweg sehr scharf, während die vorangehende schon in wenigen Minuten Entfernung vom Kern sehr verwaschen war, indem das Licht allmälig abfiel. Aus diesem Grunde kann die letzte Zeitangabe nur auf eine vergleichsweise geringere Genauigkeit Anspruch machen.

"Heute wurde, zum ersten Mal mit blossem Auge, deutlich ein mit dem Hauptschweife einen spitzen Winkel bildender schmaler Nebenschweif gesehen, welcher um $20^h\ 20^m$ Sternzeit gerade auf η Ursæ Maj. gerichtet war, und auch bis in die Nachbarschaft dieses Sterns verfolgt werden konnte. Seine hellste Stelle hatte er nicht etwa auf dem Punkte, wo er von dem Hauptschweife abzweigte, sondern etwa auf ein Drittel der Entfernung von demselben bis η Ursæ. Seine Breite verändert er nur sehr wenig in der ganzen Ausdehnung.

"Zur genaueren Verzeichnung des Schweifes wurden heute noch folgende Einstellungen verschiedener Puncte seiner Begränzung, am Sucher des Refractors gemacht, die für die mittlere Epoche $21^h\ 5^m$ gelten.

Kern. AR. $= 13^h\ 9^m\ 36^s$ Dec. $= +29°\ 58'$

AR. vorangeh. Begränzung.	Dec. gemeinschaftlich.	AR. nachfolgende Begränzung.
$13^h\ 9^m\ 28^s$	$+30°\ 10'$	$13^h\ 10^m\ 16^s$
9 35	30 20	10 37
9 40	30 35	11 2
9 47	30 55	11 35 *
9 26	31 37	12 22 †
9 31	32 53	13 38
10 2	34 47	15 0
9 37	36 37	15 29
8 38	37 59	15 59
	41 2	15 2 ‡
	+44 7	10 59 ‡

"Die Stelle der nachfolgenden Begränzung des Schweifs, deren Position durch AR $= 13^h\ 15^m\ 59^s$, Decl. $= +37°\ 59'$ gegeben ist, bezeichnet nahezu den Ort, wo der auf η Ursæ Maj. gerichtete Nebenschweif seinen Anfang nimmt.

"Anmerkung. Die beiden letzten Einstellungen bei beiden Schweifhälften, dürfen wohl nicht als äusserste Begränzungspunkte des Schweifs gelten, sondern bezeichnen

* "Auf diesem Parallel verschwand die letzte Spur der Theilung des Schweifs."

† "Hier schon die vorangehende Seite sehr unbestimmt."

‡ "Bei diesen beiden Einstellungen auch die nachfolgenden Seite schon sehr unbestimmt."

nur näherungsweise die Richtung der Gränzen des hellsten Lichts in demselben; während die ersten Bestimmungen, wo die Gränze scharf zu erkennen war, wirklich dazu dienen können die Form und Ausdehnung des Cometen zu ermitteln.

"Mit dem blossen Auge konnten die letzten Spuren des Schweifs bis in die Nachbarschaft der Sterne ζ und ϵ Ursæ Maj. verfolgt werden. Hieraus würde sich die Länge des Schweifs auf beiläufig 25° ergeben und seine Breite am Ende auf ungefähr 4°."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 31, 32.)

"Die schmale dunkle Zone theilt den Schweif in zwei ungleiche Hälften, so dass die vorangehende die kleinere ist; den Positionswinkel derselben ergaben drei Einstellungen zu 15°.1′.

"Im Heliometer fand sich:

Abstand vom Kopfe, 5′	Breite des hellen Schweifs, 5′
" " " 10′	" " " " 7′
" " " 26′	" " " " 14′.5

"Die schwache Umhüllung steht von der hellen ab:

Entfernung vom Kopfe, 5′	vorgehend, 2′	folgend, 4′.0
" " " 10′	" 1′	" 2′.3

In 26′ Abstand nicht mehr bestimmbar.

"Das allmälige Auslaufen der vorangehenden Schweifseite und die viel schärfere Begränzung der folgenden wird immer auffallender.

"Aus den Einzeichnungen des Schweifes in den Harding'schen Atlas gaben sich folgende Daten. (Eq. 1800.0.)

"Coordinaten des Schweifrandes:

δ = 34°	0′	folgend, α =	197°	45′	vorgehend, α =	196°	42′
36	0	"	198	2	"	196	34
38	0	"	198	9	"	196	21
40	0	"	198	9	"	196	10
42	0	"	198	4			
44	0	"	197	47			
46	9	"	197	16			

"Breite des Schweifes:

Abstand vom Kerne.	Breite des Schweifes.
180′	43′
240′	52′
300′	64′
360′	72′
420′	77′
480′	82′

Endpunkt der Mitte des schwachen Schweifes	200° 36′	+42° 2′	Breite 16′
Coordinaten der Mitte	198 29	36 0	
	199 12	38 0	
	199 52	40 0	
Absprossungspunkt vom Hauptschweife:	197 8	+33 9	

Länge des Schweifes fürs blosse Auge 19°."

TRETIRE, HEREFORD, ENG. WEBB. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. pp. 22, 23, 352.)

"The proportion of the dusky streak to the whole breadth of the tail was estimated at $\frac{1}{8}$. . . . . . With the large object glass, on September 30, it (the bright branch) was estimated the broader in the ratio of about 4 to 3."

"At the end of September and during the first few days of October, the central darkness in the train, though very intense, occupied a comparatively small part of its whole breadth. My own estimate on September 30 gave it but one eighth of the entire width of the tail."

VIENNA. . . . . . (*Annalen der Wiener Sternwarte*, F. III., IX. p. 178.)

"Am 30 September war die Trennung des Schweifes in zwei gesonderte Aeste besonders schön zu beobachten."

Plate VIII. represents the naked-eye view of the Comet on September 30th. The indication of a deflection of the faint light of the upper part of the tail is to be noticed. The outlines of the tail are given on Plate XXVI. Section I., and on Plate XXIV., which also shows the position of the secondary tail. The telescopic view is given on Plate XXXIV.

1858. October 1. (Plates IX., XXIV., and XXVI. Section I.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, pp. 216, 217.)

"Særdeles mærkeligt var det, at der lige fra Kjærnen udgik en smal, meget snever *mærk Stribe,* saa paafaldende sort, og i Særdeleshed paa den hoeire Side (i Kikkerten) saa skarpt begrændset, at den aldeles gjorde Indtrykket af en *Skygge.* . . . . . Halen strakte sig idag indtil Stjernen η Urs. Maj.; dens Længde var idetmindste nogle og tyve Grader, og ved Enden var den rigelig ni Grader bred."

BERLIN. BRUHNS. (*Astron. Nachrichten*, 1205, p. 73.)

"Verfolge ich den Schweif 18°."

HIGHBURY, ENG. BURR. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 26.)

"The tail was 21° in length."

FLORENCE. DONATI. (*Bulletin Obs. Imp. de Paris.*)

"Longueur de la queue 27°."

OPORTO, PORTUGAL. BARON DE FORRESTER. (*Mss. communicated.*)

Sketch of the tail and stars in its neighborhood.

GÖTTINGEN. LISTING. (*Astron. Nachrichten*, 1167, p. 233.)

"Der sehr brillante gekrümmte Hapttheil des Schweifs, dessen Ausdehnung ich auf 23° schätzte, so wie die Breite auf etwa 4° an der ungefähr 15 bis 18 Grad vom Kopf entfernten Gegend, zeigte zur Linken eine sehr zarte, lichtschwache Abzweigung, welche in der Entfernung von 5° bis 6° vom Kopf aufwärts erst die Trennung von dem Hauptschweif einigermaassen deutlich erkennen liess, sich zu der linken Grenze des hellen Schweifs, welche merklich bestimmter begrenzt erschien als die rechte, wie eine geradlinige Tangente zur Curve verhielt und sich fast auf gleiche Länge wie der Hauptschweif erstreckte."

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, p. 314; 1173, pp. 337, 338.)

A chart of the Comet among the stars with the following notes:—

"Auffallend war es, dass die beiden Aeste des Schweifs, welche die Fortsetzung der mittl. Zone bildeten, stärker gegen einander geneigt waren, als Sept. 28. . . . . .

"Die Figur des Schweifes hatte sich seit Sept. 28 erheblich geändert. Die Krümmung der vorangehenden Seite war stärker geworden, die nachfolgende rechte dagegen schien noch weniger gut begrenzt als früher. Die Zunahme an Grösse und Helligkeit war auffallend. . . . . .

"Beobachtete Puncte im vorangehenden Schweifrande:

M. B. Z.	α 1858.0	δ 1858.0	α ☄	δ ☄
Octbr. 1.350	202° 28′	+37° 55′	200° 17′	+28° 19
1.350	199 36	+50 26		

"Beobachtete Puncte im nachfolgenden Schweifrande:

M. B. Z.	α 1858.0	δ 1858.0
Octbr. 1.350	198° 30′	+41° 20′."

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 262.)

"Der Schweif, bei 25 Grade lang, ist stärker gekrümmt als an den vorhergehenden Tagen, der dunkle Streifen hinter dem Kerne bedeutend länger."

OXFORD. SLATTER. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 24.)

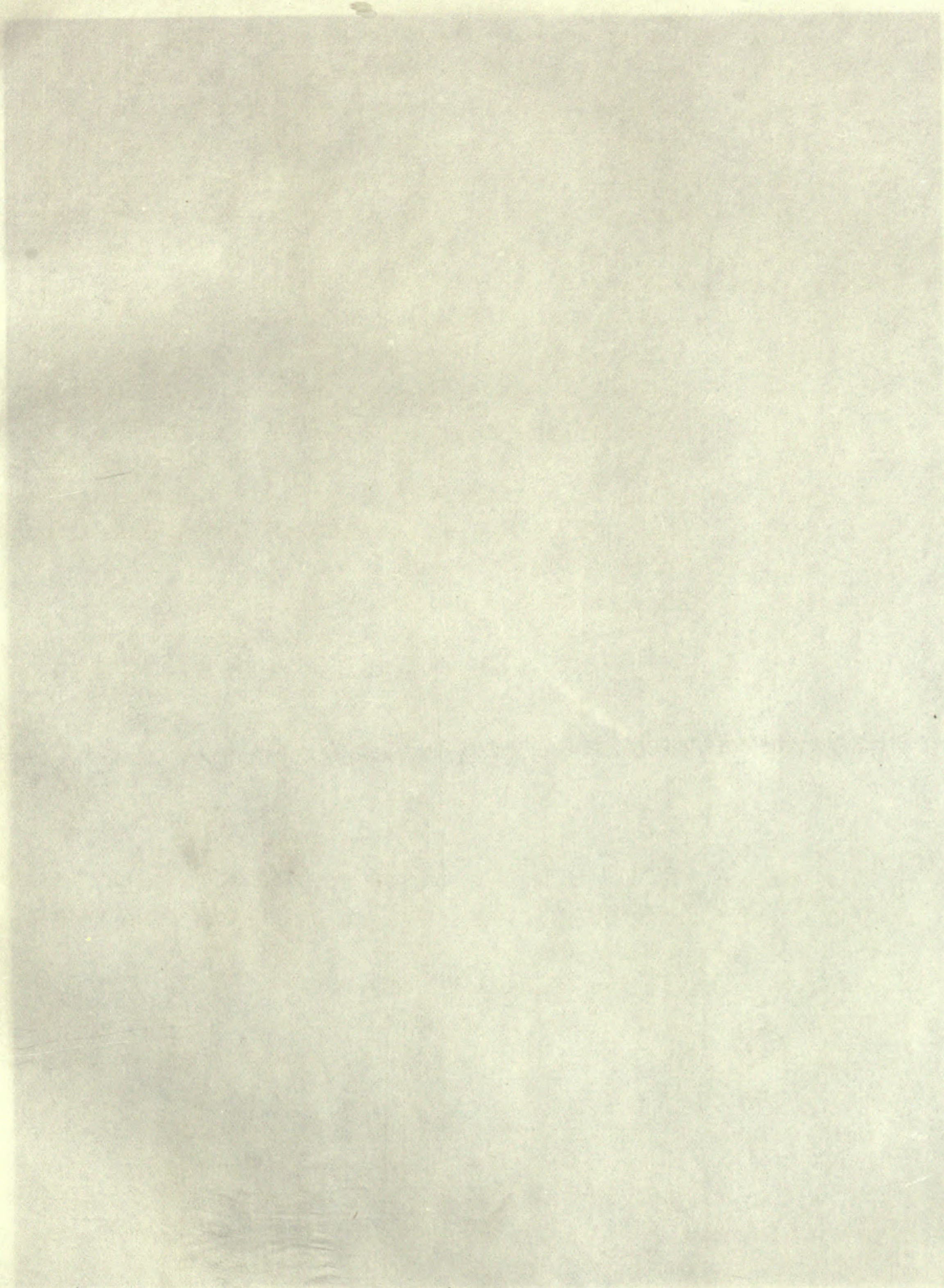
"Measuring through the nucleus, i. e. if parabolic, the parameter = 4′.1."

The appearance of the Comet to the naked eye on October 1st is represented on Plate IX., and the outlines of the tail and secondary tail on Plate XXVI. Section I. and Plate XXIV.

1858. October 2. (Plates X., XXIV., XXVI. Section II., and XXXV.)

GREENWICH. AIRY. (*Monthly Notices Royal Astr. Soc.*, VOL. XIX. p. 12.)

"7^h m. s. t. The tail when it left the head pointed at first not quite to α Draconis, but to a place between α Draconis and γ Ursæ Minoris, but nearer the former; the curvature then made the extremity of the tail point to the



[illegible] p. 288.)

[illegible] des [illegible]

[illegible] 18

[illegible] sich

[illegible] begrenzt

[illegible] zurhielt und sich

[illegible]

[illegible] welche die Fortsetzung

[illegible] waren, als Sept. 28. . . . . .

[illegible] erheblich geändert. Die

[illegible] geworden, die nachfolgende

[illegible] als früher. Die Zunahme an

[illegible]

		[illegible]	+28° 19

[illegible] Puncte [illegible]

M. B. Z.		δ 1858.0
Octbr. 1.350		+41° 29′ [illegible]

[illegible] RESLHUBER.

[illegible] bei 25 [illegible]

[illegible] 4′.1.″

[illegible] represented

[illegible] on Plate XXVI.

[illegible] XXXV.)

[illegible] p. 12.)

[illegible] at first not quite to α

[illegible] γ Ursæ Minoris, but nearer

[illegible] extremity of the tail [illegible] the

PLATE IX.

G.P. Bond Del.

J.W. Watts Sc.

COMET OF DONATI 1858.

OCTOBER 1st 7h M.S.T. OBSERVATORY OF HARVARD COLLEGE.

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right (or to the lower side) of η Ursæ Majoris, its length being equal to the distance from α to η Ursæ Majoris. I could almost fancy that a more brilliant part of the tail proceeded straight from the head in the first-mentioned direction, and a fainter part was then attached to its side."

OBSERVATORY OF HARVARD COLLEGE. W. C. BOND.

"At 7^h 15^m m. s. t. the convex side passed through the group of stars B. A. C. 4627, 4628, 4632. The concave edge passed over B. A. C. 4536. The tail was 4° broad opposite Benetnasch (η Ursæ Majoris). It reached a point 1° or 2° below that star, between it and Mizar."

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

8^h m. s. t. The angle between the tangents to the outer margin of the tail, where its brightness pretty suddenly diminished, was 31°, at a distance of from 6′ to 8′ from the nucleus. "I can scarcely discern any light beyond a distance of 2′ from the nucleus in a direction towards the sun, and there is very little beyond 1′ 30″." The breadth of the tail was 5′ at 8′ from the nucleus; in the comet-seeker the central darkness inclined towards the faint side of the tail. The tail was tolerably bright as far as η Ursæ Majoris, and by glimpses reached barely to Mizar (29°). The sketches show a well-marked deflection of the front edge at a little beyond 20° from the nucleus.

OBSERVATORY OF HARVARD COLLEGE. R. F. BOND.

The tail near the head was directed to the south of η Ursæ Majoris, passing 1° or 2° below that star. The end reached a point between η and ζ Ursæ Majoris. Near Cor Caroli the breadth was 2° or 3°. Several sketches of the tail were made.

HIGHBURY, ENG. BURR. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 26.)

"A fine dark division in the tail was apparent, reaching from the head for about a degree in length, which subsequently became wider and larger."

CAMBRIDGE, ENG. CHALLIS. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. pp. 18, 20.)

"7^h 15^m m. s. t. A dark and rather broad band divided the tail into two parts, which, at a considerable distance from the head, overlapped each other. A drawing represented the right-hand branch of the tail considerably the brighter, but the form and appearance of the head was now symmetrical about its axis. To the naked eye the tail was much more sharply defined on the southern than on the northern side, and was widely spread out at the extremity. Its length was 33°, as measured on a celestial globe, by reference to Arcturus, which was very close to the nucleus, and to stars of Ursa Major."

"In the course of the observations, my attention was especially directed to the

following particulars, respecting which I can speak with confidence. The brightness contiguous to the nucleus preponderated on the right side (as seen in the telescope) till October 2, and on October 9 the excess had passed to the left side. The excess of brightness of the right-hand stream of the tail above that of the other attained its maximum about October 2, after which there was a gradual diminution, till, on October 11, 15, and 16, the two streams were not sensibly unequal. The dark band separating the two portions of the tail was of uniform width and definite boundary on September 30 and October 2; and in proportion as the boundaries afterwards became indefinite, and the intervening space was gradually filled with luminosity, the angular divergence of the two streams also increased."

VIENNA. HORNSTEIN [?]. (*Annalen der Wiener Sternwarte*, F. III., IX. p. 178.)

"Die dunkle Mittellinie zwischen beiden Aesten des Schweifes war sehr gut sichtbar, und auf eine beträchtliche Entfernung vom Kerne zu verfolgen. Hier folgen einige Messungen bezüglich des Schweifes, welche durch Einstellung des 6 zölligen Refractors auf verschiedene Declinationen gewonnen wurden, in dem bei jeder einzelnen Stellung die Zeit notirt wurde, wann die Ränder, die hellsten Theile der beiden Schweifäste und die dunkle Mittellinie im Centrum des Gesichtsfeldes waren. Mit Rücksicht auf die Fehler des Instrumentes und durch Reduction aller Beobachtungen auf eine gemeinschaftliche Zeit mittelst der bekannten Bewegung des Cometen wurden nachstehende Positionen erhalten: —

Mittlere Wiener Zeit: $7^h\ 33^m$; Position des Kernes: $\alpha\ 13^h\ 31^m\ 45^s$, $\delta\ +26°\ 39'$.

	δ +26° 45′	δ +27° 11′	δ +28° 37′	δ +30° 2′
	h m s	h m s	h m s	h m s
Westlicher Rand des Schweifes .	α 13 31 44	α 13 32 8	α 13 32 41	α 13 0 0
Hellste Linie im westl. Aste . .	31 50			
Schweifaxe	31 56	33 2	33 41	36 14
Hellste Linie im östl. Aste . .	32 5			
Oestlicher Rand des Schweifes . .	32 16	33 26	34 9	37 53
Hieraus folgt:				
Breite des ganzen Schweifes senkrecht gegen seine Längenrichtung	6′.6	15′.9	17′.9	19′.8 (?) " *

DORPAT. LAIS. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. p. 57.)

"Der Schweif reicht bis η Urs. Maj., und eine Messung mit dem Sextanten gab die Entfernung des Kerns von η Urs. Maj. = 23° 30′. Er zeigte eine sehr ins Auge fallende, scharf begrenzte Krümmung, deren convexe Seite sehr hell, während die concave matt und verwaschen erschien. Auch an Breite hat der Schweif auffallend zugenommen (dunkle Nacht)."

* This is the distance of the east edge from the axis.

following particulars, respecting which I can speak with [illegible]. The brightness contiguous to the nucleus preponderated on the [illegible] side (as seen in the telescope) till October 2, and on October 9 the [illegible] had passed to the left side. The excess of [illegible] of the right-hand [illegible] of the tail above that of the other attained [illegible] about October [illegible], after which there was a gradual diminution, till, on October 11, 15 and [illegible] [illegible] were not sensibly unequal. The dark band separating the [illegible] of the tail was of [illegible] width and [illegible] boundary on [illegible] and October 2; and in proportion as the [illegible] became [illegible] the intervening space was gradually [illegible], the angular [illegible] of the two streams also increased."

[illegible] [7]. (*Annalen der Wiener Sternwarte*, F. III., IX. p. 178.)

"Die dunkle Mittellinie zwischen beiden Aesten des Schweifes war sehr gut sichtbar, und auf eine [illegible] Entfernung vom Kerne zu verfolgen. Hier folgen einige Messungen [illegible] des Schweifes, welche durch Einstellung des 6 [illegible] Refractors [illegible] Declinationen gewonnen wurden, in dem bei jeder einzelnen [illegible] die Zeit notirt wurde, wann die Ränder, die hellsten Stellen der [illegible] und die dunkle Mittellinie im Centrum des Gesichtsfeldes waren. [illegible] auf die Fehler des Instrumentes und durch Reduction aller Beobachtungen auf eine gemeinschaftliche Zeit mittelst der bekannten Bewegung des [illegible] nachstehende Positionen erhalten: —

[illegible] Position des Kernes: α 15h 31m 45s, δ +26° 39′.

	[illegible]	δ +27° 11′	δ +28° 37′	δ +30° 2′
W[illegible]	α 15 31 44	α 15 32 8	α 15 33 41	α [illegible]
[illegible]	31 50			
[illegible]	31 56	33 2	33 41	36 14
[illegible]	32 5			
[illegible]	[illegible]	32 36	34 9	37 53

[illegible] 13.8 (?) " *

[illegible] dem Sextanten gab [illegible] zeigte eine sehr ins Auge [illegible] Seite sehr hell, während die [illegible] an Breite hat der Schweif auffallend [illegible]"

* [illegible] of the east edge from the axis.

PLATE X.

G.P. Bond Del. J.W. Watts Sc.

COMET OF DONATI 1858.

OCTOBER 2ND 7^{H} M.S.T. OBSERVATORY OF HARVARD COLLEGE

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DORPAT. MÄDLER. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. p. 44.)

"Der Schweif, der vom Kopfe aus in der Mitte eine Längspalte zeigte, so dass nur die äussersten Theile einen einfachen Zug bildeten, erreichte η Ursæ Majoris, war also 24° lang."

ALTONA. PAPE. (*Astron. Nachrichten*, 1173, pp. 337, 338.)

"Beobachtete Puncte im vorangehenden Schweifrande :

M. B. Z.	α 1858.0	δ 1858.0	α ☄	δ ☄
Octbr. 2.301	205° 42′	+39° 16′	202° 57′	+26° 39′
2.301	202 46	+49 44		

"Beobachtete Puncte im nachfolgenden Schweifrande :

M. B. Z.	α 1858.0	δ 1858.0
Octbr. 2.301	201° 42′	+39° 31′ "

MADRAS. POWELL. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 64.)

"The eastern or convex edge of the envelope sharper and brighter than the other; the curvature, too, on the following side much greater than on the preceding. The tail extending from two thirds to three fourths of the distance to η Ursæ Majoris, or about sixteen degrees."

ALBANY. SEARLE AND TOOMER. (*Astron. Journal*, No. 127, p. 51, and No. 119, p. 183.)

"Front edge of the tail.

Wash. m. s. t.	α	δ
October 2.310	205° 5′	+28° 45′
2.310	206 0	31 0
2.310	207 0	35 0
2.310	207 15	40 0
2.310	206 50	+46 15

Length of Tail 26°, max. breadth 4°. Toomer.
" " 24 " " 5°. Searle."

KINGSTON, CANADA WEST. WILLIAMSON. (*Canadian Journal*, III. p. 486.)

"The tail was 20° in length."

The appearance of the Comet to the naked eye on October 2 is represented on Plate X.; the outlines of the tail and the secondary tail, on Plate XXVI. Section II., and Plate XXIV.; and the telescopic view, on Plate XXXV.

1858. October 3. (Plates XI., XXIV., and XXVI. Section II.)

GREENWICH. AIRY. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 13.)

"The centre of curvature of the southern edge of the Comet's tail was about 3° below Canum Venaticorum (Cor Caroli)."

GÖTTINGEN. AUWERS. (*Astron. Nachrichten,* 1167, p. 236.)

"Der andre (Hauptschweif) 26°."

BRESLAU. GALLE. (*Astron. Nachrichten,* 1179, pp. 38, 39.)

"8^h m. Z. Der Schweif war bis in die Gegend von η Ursæ Maj. deutlich erkennbar; der hellste Theil desselben ging in der Mitte zwischen λ Bootis und η Urs. Maj. hindurch, die äusserste Grenze links näher an λ Bootis. Die Grenze rechts breitete sich in der Richtung auf ζ Urs. Maj. hinaus. Die Grenze links war, auch im Fernrohr, viel bestimmter als die Grenze rechts, welche ihrer ganzen Länge nach verwaschener war. Der ganze Schweif war, von dem sehr hellen Kerne an, in zwei Hälften getheilt, welche durch einen dunkleren Zwischenraum von einander getrennt waren. Im Cometensucher erschien der Zwischenraum als eine scharfe, schmale dunkle Linie (einem vom Kern geworfenen Schatten ähnlich) im Fernrohr etwas breiter und mit verwaschenen Grenzen. Dieser dunkle Streifen wurde in einiger Entfernung vom Kopfe breiter, liess sich jedoch nur einige Grade, nicht bis an das Ende des Schweifes, verfolgen, wo dann der Schweif in seiner ganzen Breite ein nahezu gleichförmig verwaschenes Ansehen hatte und nur die hellere Mitte des linken Zweiges etwas überwiegend blieb. Der linke Zweig, der dunkle Streifen und der rechte Zweig verhielten sich in der Nähe des Kopfes rücksichtlich ihrer Breite $= 3:1:2$."

MÜNSTER. HEIS. (*Astron. Nachrichten,* 1169, p. 269.)

"Schweiflänge 25°."

MEADVILLE, PA. KENDALL.

A photograph copy from an original drawing by Mrs. J. Kendall, representing the appearance of the Comet in the evening twilight, has been communicated to me by Hon. William Mitchell of Nantucket.

MADRAS. POWELL. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 64.)

"The tail brighter and longer than last night, extending very nearly to η Ursæ Majoris."

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten,* 1169, p. 262.)

"Schweiflänge bis 30 Grade. Anblick des Kometen prachtvoll."

VIENNA. SCHMIDT. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge 30° (sehr klar).
Grösste Breite des Schweifes 3.0."

VIENNA. WEISS [?]. (*Annalen der Wiener Sternwarte,* F. III., IX. p. 179.)

"Der dunkle Raum zwischen beiden Schweifästen war sehr gut sichtbar, und schien sich bis näher an den Kern hin zu erstrecken, als an den vorhergehenden Tagen; er war auf der Seite des helleren Astes geradlinig begrenzt, auf der

[illegible] Nachrichten, [illegible], p. [illegible]

"Der erste (Hauptschweif), [illegible]"

[illegible] Nachrichten, [illegible]

"[illegible] Der Schweif war bis in die Gegend [illegible] deutlich er-
kennbar [illegible] und
[illegible] die äussere Grenze [illegible] Die Grenze
[illegible] Grenze links
[illegible] ihrer ganzen
[illegible] war. [illegible] sehr hellen
[illegible] Zwischenraum
[illegible] getrennt waren. [illegible] Zwischenraum als
eine scharfe schmale dunkle [illegible]
[illegible] Dieser dunkle Streifen
[illegible] nur einige Grade,
[illegible] Schweif in seiner
ganzen [illegible] hatte und nur die
[illegible] Der linke Zweig, der
dunkle [illegible] in der Nähe des Kopfes
[illegible]"

[illegible]

[illegible] representing
[illegible]

[illegible] to η

[illegible]

"Der dunkle [illegible] sichtbar, und
schien [illegible] vorhergehenden
Tagen [illegible] auf der

PLATE XI

G. P. Bond Del.

J. W. Watts Sc.

COMET OF DONATI 1858.

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anderen gebogen und zwar derart, dass die concave Seite gegen den dunklen Theil gewendet war. Die Position der vorzüglichsten Theile des Schweifes wurde analog wie am 2 October bestimmt.

"Mittlere Wiener Zeit: $7^h\ 59^m$; Position des Kernes: $\alpha\ 13^h\ 43^m\ 44^s$, $\delta\ +24°\ 34'$.

	$\delta\ +24°\ 48'$	$\delta\ +25°\ 6'$	$\delta\ +25°\ 26'$	$\delta\ +25°\ 54'$	$\delta\ +26°\ 25'$	$\delta\ +26°\ 55'$
	h m s	h m s	h m s	h m s	h m s	h m s
W. Ast, Westl. Rand	α 13 44 20	α 13 44 57	α 13 45 12	α 13 45 36	α 13 45 43	α 13 46 23
" Hellste Linie	44 31	45 15	45 36			
" Oestl. Rand	44 38	45 22	45 44			
O. Ast, Westl. Rand	44 47	45 38	45 58			
" Hellste Linie	44 58	45 53	46 20			
" Oestl. Rand	45 14	46 13	46 47	47 46	48 47	49 42
Hieraus folgt: —						
Breite des ganzen Schweifes senkrecht auf seine Längenrichtung	10′.8	15′.2	19′.0	25′.9	36′.5	39′.5

	$\delta\ +27°\ 55'$	$\delta\ +28°\ 56'$	$\delta\ +29°\ 56'$	$\delta\ +30°\ 56'$	$\delta\ +31°\ 57'$
	h m s	h m s	h m s	h m s	h m s
Oestl. Ast, Oestl. Rand	α 13 51 24	α 13 52 47	α 13 54 4	α 13 55 20	α 13 56 17

"Die beiden letzten Positionen sind sehr unsicher. Dem freien Auge bot der Comet ein prachtvolles Bild. Insbesondere hatte der Schweif sehr bedeutende Dimensionen angenommen. Sein Ostrand liess sich bis η im grossen Bären verfolgen; seine Gesammtlänge betrug also 25 bis 26 Grad."

The appearance of the Comet to the naked eye on October 3 is represented on Plate XI.; the outlines of the principal tail, on Plate XXVI. Section II.; and the secondary tail, on Plates XI. and XXIV.

1858. October 4. (Plates XII., XXIV., XXVI. Section II., and XXXVI.)

GÖTTINGEN. AUWERS. (*Astron. Nachrichten*, 1167, p. 236.)

"Hauptschweif 28°."

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"$7^h\ 30^m$ m. s. t. Curved bright tail extends over Benetnasch and Mizar" (η and ζ Ursæ Majoris).

BERLIN. BRUHNS. (*Astron. Nachrichten*, 1205, p. 73.)

"Verfolgte ich den Schweif . . . . . bis zu 20° Länge, viel weiter habe ich nie ihn verfolgen können, woran vielleicht die hier im Westen und Norden des Abends durch Rauch getrübte Luft Schuld sein mag."

MARKREE. COOPER, GRAHAM, AND ROBERTSON. (*Obs. of Donati's Comet* 1858, *Markree*, p. 10.)

"10^h m. s. t. Only portions of the tail were seen by me through clouds; it appeared broader and much more diffused on the preceding or western side than on

any former night; as Mr. Cooper very aptly expresses it, it looked more feathery; the following side was brighter and better defined. About ten o'clock, the tail was seen free of clouds by Mr. C. Robertson; λ Boötis was in its axis, and he sometimes fancied it stretched up as far as to ι and $\varkappa$ Boötis, which would give a length of 30 degrees."

OPORTO. PORTUGAL. BARON DE FORRESTER. (*Mss. Copy communicated.*)

Chart of the Comet and stars in its vicinity.

BRESLAU. GALLE. (*Astron. Nachrichten,* 1179, p. 39.)

"Der Schweif erstreckte sich heute bis in die Gegend von γ and λ Boötis, so dass die hellere linke Seitenlinie auf die Mitte zwischen diesen beiden Sternen gerichtet war, die rechte verwaschene Seite des Schweifes war auf η Ursæ Maj. gerichtet. Die linke Seite als Kreisbogen betrachtet begrenzte ein Kreis-Segment, dessen Höhe ich gleich $\frac{1}{8}$ der Länge der Sehne schätzte. Die dunkle Trennungslinie zwischen den beiden Zweigen war im Cometensucher bis etwa 2° Entfernung vom Kopfe erkennbar. Dieselbe erschien, besonders im $4\frac{1}{2}$ ff. Fraunh. bei 72 mal Vergr. etwas breiter als gestern; der linke Zweig, der dunkle Streifen und der rechte Zweig verhielten sich in der Breite = 3 : 2 : 2."

LIVERPOOL. HARTNUP. (*Monthly Notices Royal Astr. Soc.,* Vol. XIX. p. 56.)

"Distance from nucleus to end of tail 31° 30′. Greatest diameter 6°."

MÜNSTER. HEIS. (*Astron. Nachrichten,* 1169, p. 269.)

"Lag die obere Grenze des Schweifes zwischen *c*, *k* (ι and $\varkappa$?) Boötis und η Ursæ. Die grösste Breite betrug etwa 10°. Luft sehr heiter."

VIENNA. HORNSTEIN [?]. (*Annalen der Wiener Sternwarte,* F. III., IX. pp. 179, 180.)

"Mit freiem Auge gesehen, streifte der Ostrand des Schweifes A Boötis, und bog sich dann bis ι Boötis zurück; die Schweiflänge betrug gegen 30 Grade. Für die Stellung und die Dimensionen der helleren Theile wurden folgende Positionen erhalten:—

Mittlere Wiener Zeit: $8^h\ 15^m$; Position des Kernes: $\alpha\ 13^h\ 55^m\ 58^s$, $\delta\ +22°\ 14'$.

	$\delta\ +22°\ 20'$	$\delta\ +22°\ 36'$	$\delta\ +22°\ 51'$
Westlicher Ast, Westlicher Rand .	$\alpha\ 13^h\ 55^m\ 55^s$	$\alpha\ 13^h\ 56^m\ 19^s$	$\alpha\ 13^h\ 56^m\ 42^s$
" " Hellste Linie	56 1	56 33	57 1
" " Oestlicher Rand . .	56 8	56 44	57 15
Oestlicher Ast, Westlicher Rand	56 16	57 1	57 31
" " Hellste Linie . . .	56 24	57 10	57 49
" " Oestlicher Rand	56 37	57 31	58 17
Hieraus folgt:			
Breite des ganzen Schweifes senkrecht auf seine Längenrichtung	8′.2	14′.0	18′.4

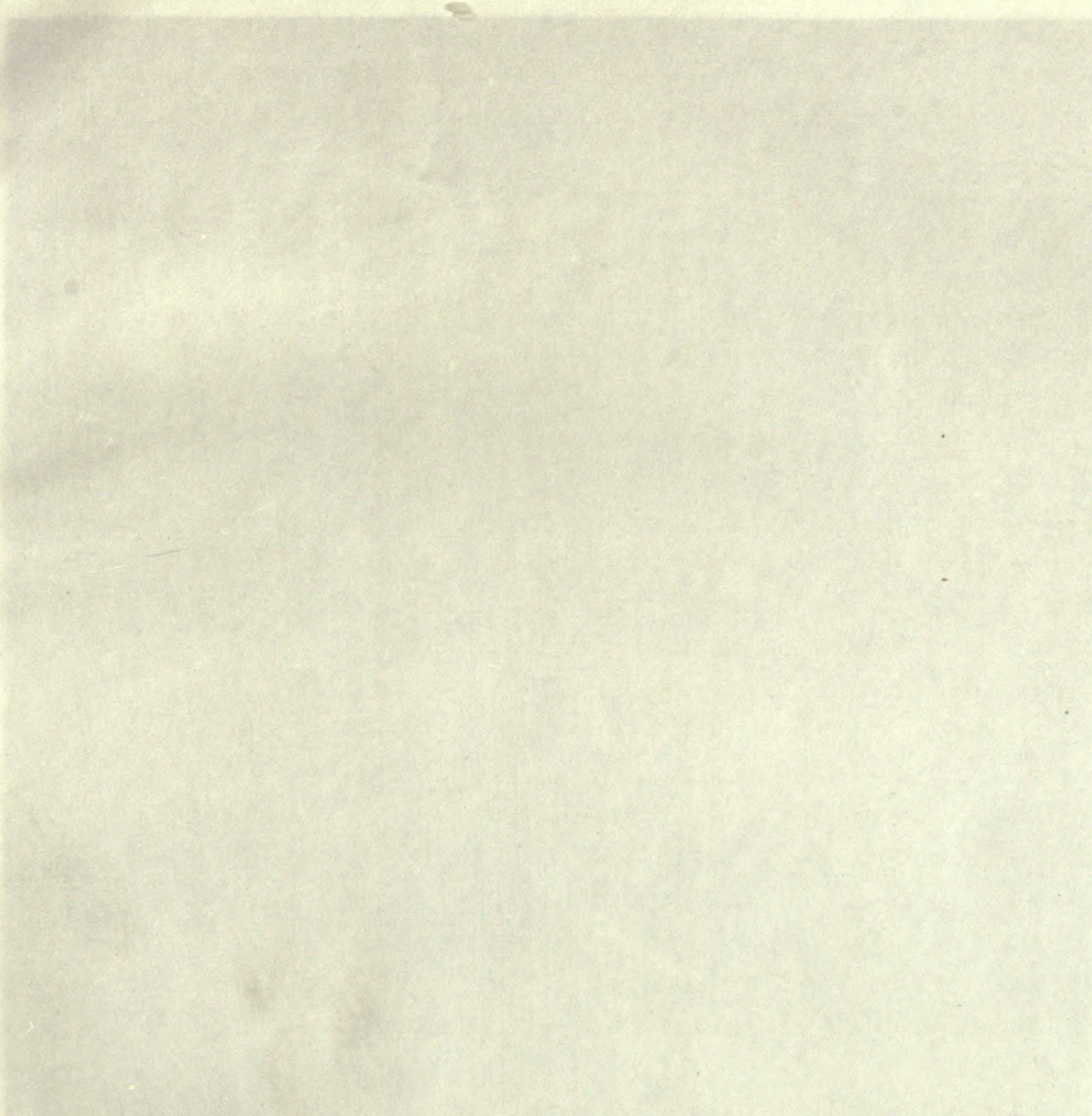

PLATE XII.

G.P. Bond Del.

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COMET OF DONATI 1858.

OCTOBER 4TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE.

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	δ +23° 22′	δ +23° 52′	δ +24° 23′
Westlicher Ast, Westlicher Rand	$13^h\ 57^m\ 28^s$	$13^h\ 57^m\ 44^s$	
Dunkelste Linie zwischen beiden Aesten . .	58 48	59 49	
Oestlicher Ast, Oestlicher Rand . . .	59 44	14 0 49	$14^h\ 2^m\ 6^s$
Hieraus folgt:			
Breite des ganzen Schweifes senkrecht auf seine Längenrichtung	26′.3	35′.7	
	δ +24° 53′	δ +25° 53′	δ +26° 53′
Oestlicher Ast, Oestlicher Rand . . .	$14^h\ 2^m\ 46^s$	$14^h\ 5^m\ 6^s$	$14^h\ 7^m\ 13^s$"

DORPAT. MÄDLER. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. p. 44.)

"Erfolgte eine theilweise Aufheiterung erst um die Zeit des Untergangs des Cometenkopfes. Man konnte nur bemerken, dass der über dem Horizont sichtbare Theil des Schweifes an η Ursæ Majoris westlich vorbeizog und weiter als am 2ten reichte, also gegen 30° lang sein musste."

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, p. 315, and 1173, pp. 337, 338.)

"Der linke Schweifast war in der Dämmerung erheblich heller als der rechte (vorangehende). . . . . .

"Die beiden Aeste des Schweifes, die sich Octbr. 1 und 2 noch scharf von dem sie umgebenden Nebel abhoben, waren heute durchaus verwaschen; die dunkle Zone zwischen ihnen schlecht begrenzt und weniger dunkel als früher. . . . . .

"Beobachtete Puncte im vorangehenden Schweifrande:

M. B. Z.	α 1858.0	δ 1858.0	α ☄	δ ☄
Octbr. 4.347	215° 2′	+36° 10′	209° 3′	+22° 11′
4.347	213 55	+46 38		

"Beobachtete Puncte im nachfolgenden Schweifrande:

	α 1858.0	δ 1858.0
Octbr. 4.347	206° 51′	+39° 55′

"In der Beschreibung der Erscheinungen (§ 1) habe ich häufig erwähnen müssen, dass ich den vorangehenden Rand des Schweifes weit heller und schärfer begrenzt gesehen habe, als den nachfolgenden. Ebenso zeigte die Betrachtung des Cometen im Fernrohr, dass der vorangehende Schweifast bis etwa Octb. 4 beständig breiter und heller war als der linke, so dass offenbar eine grössere Menge der vom Cometen ausströmenden Theilchen nach der Richtung hingedrängt wurde. . . . . . Erst am 4ten October sah ich im Fernrohr mit Sicherheit dass der nachfolgende Schweifast erheblich heller war, als der vorangehende."

MADRAS. POWELL. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 64.)

"The outline of envelope indistinct even on the upper or following side, showing

in this respect a decided change since last night. A dark axial space visible down the envelope for the first time; η Boötis lying before the head, and almost in the direction of the tail, which is about 24° long."

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 262.)

"Schweif bei 35 Grade lang, an der breitesten Stelle 6 Grade breit."

COLLEGIO ROMANO. SECCHI (ROSA). (*Mem. dell' Osserv. del Collegio Romano*, 1859, p. 14.)

"La coda questa sera si estendea fino a λ Boote."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 8.)

"In der Nacht wurde es spät auf kurze Zeit klar. Um 2^h Morgens reichte der Schweif entschieden über θ Boötis hinaus, während der Kern noch unter dem Horizonte sich befand. Hiernach wäre die Länge des Schweifs auf mindestens 35° zu schätzen; wahrscheinlich darf sie aber noch erheblich grösser angenommen werden, da die Luft nicht vollkommen durchsichtig war."

TRETIRE, HEREFORD, ENG. WEBB. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. pp. 22, 23.)

"The central darkness was traced 2° or 2° 30′ before it was merged in the general brightness. The breadth of the two streams which formed the tail was as 3 to 2."

The aspect of the Comet to the naked eye on October 4 is represented on Plate XII.; the outlines of the principal tail, on Plate XXVI. Section II. On Plates XI. and XXIV. the two secondary tails are represented; the position of the latest of these (the uppermost) cannot be relied upon, as it has been drawn to conform with the sketches on subsequent evenings. It is mentioned, though not figured, in the notes of this date made at the Observatory of Harvard College. The telescopic view is shown on Plate XXXVI.

1858. October 5. (Plates XIII., XIV., XXIV., XXVI. Section II., and XXXVII.)

WORCESTER, MASS. ADAMS. (*Photographic Copy of sketch.*)

Photograph taken from a sketch of the Comet and neighboring stars.

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 217.)

"Efter nogle mœrke Aftener viste det sig den 5 October tydeligt, at den ovenfor omtalte mœrke Stribe den 1 October ikke havde været Andet, end Begyndelsen af Halens Adskillelse i to aldeles afsondrede Grene. Arktur stod i Aften lige i Halen, ikkun henved 20 Bueminuter Nord for Kjærnen. Saalænge Stjernen stod i det mœrke Mellemrum mellem begge Halens Grene, viiste der sig slet ingen Forandring i dens sædvanlige Glands og synlige Stœrrelse, og siden efter, da samme Stjerne noget senere ud paa Aftenen kom til at staae indenfor den venstre (vestlige) Grene, syntes den ikke at tabe mere, end en saa lys Baggrund nœdvendigen altid vil foraarsage. . . . . .

PLATE XIII

G.P. Bond Del. J.W. Watts Sc.

COMET OF DONATI 1858.

OCTOBER 5th 7h M.S.T. OBSERVATORY OF HARVARD COLLEGE.

Printed by Chas. D. Andrews.

"Hovedhalens Længde i Aften, efter et læst Skjøn, henved 30 Grader."

HIGHBURY, ENG. BURR. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 26.)

"Tail 28° in length."

OBSERVATORY OF HARVARD COLLEGE. W. C. BOND.

"8^h 15^m m. s. t. Length of tail 31° 45′ to the point where the light could be steadily seen; by glimpses, it could be discerned several degrees farther. Convex side was much better defined than the other."

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"The curved bright tail extends over η to ζ Ursæ Majoris, and is very broad, 5° or 6°."

The sketch accompanying the above indicates the deflection of the front edge in the upper part of the tail, bringing the front edge in the vicinity of η Ursæ Majoris, about 4° above it. On the rear side the light was diffused over a large area, in the sketch 10° or 12° broad at least. The new secondary tail was again seen.

CAMBRIDGE, ENG. CHALLIS. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 19.)

"The right-hand stream of the tail was the brighter."

GREENWICH. CHRISTIE. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 14.)

"Arcturus was in the middle of the tail at 7^h 15^m M. T.; its distance from the nucleus being as nearly as possible equal to twice the width of the tail measured through the point bisecting that distance."

HADDENHAM, ENG. DAWES. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. pp. 89, 90.)

"At 6^h 30^m G. M. T. Arcturus is just within the eastern boundary of the Comet's tail, and about 20′ north of the nucleus.

"The edge of the outer sector is much more indistinct to-night than it was some days ago, and so is also the edge of the eastern side of the tail. The inner sector is astonishingly enlarged since October 2. There is in it an irregular *dark* spot on the western side of the nucleus; and a little to the north of that dark spot, and nearer to the nucleus, there is a *bright* spot, softly defined and less bright than the nucleus.

"At 7^h 11^m Arcturus is judged to be in the middle of the tail.

"At 7^h 15^m Arcturus is in the dark channel.

"At 7^h 56^m Arcturus is just out of the tail on the western side.

"The following are measurements of angles of position and distances of the nucleus of the Comet with respect to Arcturus, the Comet *preceding* the star to the *south*: —

At 7^h 34^m 30^s	Ang. of Pos. 208°.3	Dits. 21′ 35″.6
7 39 35	205.5	
7 40 47		21 53.3
7 50 15	200.7	22 26.6

"Mr. Carrington having suggested to me to observe the angles of position of a series of tangents to the curve formed by the eastern edge of the tail, I endeavored to do so; though my apparatus is not well suited to such an observation, for which a very low power and large field would be more appropriate than those ordinarily belonging to the parallel wire-micrometer. It is essential that the points at which the wire is made a tangent should be pretty accurately determined; but this was not very easy to do. The mode which struck me as the most practicable was, to fix on certain differences of north-polar distance from the nucleus.

"Having, therefore, brought the nucleus to the cross-wires in the field, I set the declination-circle half a degree northward, and observed a tangent; and so on, at intervals of half a degree. But I found that, after the fourth setting, the edge of the tail became so diffused, that the observations could not be carried further with any certainty. The results were as follows; power 96:—

"At 0° 30′	north	of the	nucleus,	pos. of	tangent =	218°.2	G. M. T. =	8^h	23^m
1 0	"	"	"	"	"	216 .2	"	8	31
1 30	"	"	"	"	"	213 .1	"	8	33
2 0	"	"	"	"	"	212 .3	"	8	36

"The tail reaches to-night to the triangle formed by θ, ι, and $\varkappa$ Boötis, and is therefore from 30° to 35° in length."

FLORENCE. DONATI. (*Bulletin Obs. Imp. de Paris.*)

"Longueur de la queue 40°."

OPORTO, PORTUGAL. BARON DE FORRESTER. (*Copies communicated.*)

Several sketches of the tail.

CRANFORD. DE LA RUE. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 28.)

"A drawing by Mr. De La Rue, on a 20-inch celestial globe, of the appearance presented by the Comet at the Cranford Observatory on the evening of the 5th of October. The time to which the drawing corresponds is 8^h P. M., when the tail of the Comet was passing over Arcturus. The drawing gives a good idea of the apparent dimensions and curvature of the tail. It is seen passing over ϱ, σ, γ, λ, $\varkappa$, ι, and θ Boötis, extending a little beyond the three last-mentioned stars. At its greatest breadth it extends from λ Boötis to a small star, h_2, in the same constellation. The tail, roughly speaking, extends from 20° to 56° of north declination, measuring about 36° on the hour-circle passing through Arcturus."

BRESLAU. GALLE. (*Astron. Nachrichten*, 1179, p. 40.)

"Der Schweif erstreckte sich heute bis in die Gegend von γ Boötis. Die scharf begrenzte Seite desselben ging nahe bei σ Boötis links vorüber, um die halbe Distanz ϱ Boötis — σ Boötis davon entfernt."

"[illegible] suggested to me to observe the [illegible] of [illegible] formed by the eastern [illegible] tail, I [illegible] apparatus is not well [illegible] observa- [illegible] and large field would [illegible] than [illegible] the parallel wire-micrometer. [illegible] the [illegible] is made a tangent [illegible] when [illegible] very easy to [illegible] as the [illegible] fix on certain [illegible] distance from [illegible]

"[illegible] brought [illegible] in the field, I set [illegible] half a degree [illegible] a tangent, and so on, [illegible] of half a degree. [illegible] the fourth setting, [illegible] became so diffused, [illegible] not be carried further [illegible] certainty. The results [illegible]

[illegible] 30′ north of the nucleus [illegible]	[illegible]	G. M. T. =	8h 28m
1 0 " "	[illegible]	"	8 31
1 30 " "	[illegible]	"	8 33
2 0 " "	[illegible]	"	8 36

"The tail reaches to-night to [illegible] and κ Boötis, and is therefore from 30° to 35° in length [illegible]

FLORENCE. DONATI. (*Bulletin Obs.* [illegible]

"Longueur de la queue 40°."

OPORTO, PORTUGAL. BARON DE FORRESTER [illegible]

Several sketches of the tail.

CRANFORD. DE LA RUE. (*Monthly Notices* [illegible]

"A drawing by Mr. De La Rue [illegible] presented by the [illegible] the 5th of October. [illegible] when the tail of the Comet [illegible] idea of the [illegible] over ρ, σ, [illegible] mentioned stars. [illegible] in the same [illegible] to 56° of north decli- nation [illegible] through Arcturus."

[illegible]

"[illegible] von γ Boötis. Die scharf begrenzte [illegible] die halbe Distanz ρ Boötis [illegible]

PLATE XIV

G.P. Bond Del. J.W. Watts Sc.

COMET OF DONATI 1858.

OCTOBER 5TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE.

Printed by Chas. D. Andrews

. . . . . GROVE. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 29.)

"When the star had entered well within the margin of the tail, a dark notch was formed, cutting out a portion of the tail round the star; and as the star got further in, this became a dark aureola surrounding the star, and in diameter equal to about one tenth of the line of transit. This continued until the star reached the middle; at this part there is a broad dark line which extends from the nucleus to a distance considerably above the point where the star crossed. When Arcturus arrived here, this dark space was perfect up to the star, but on the other side the white light of the tail appeared to come quite up to the star; in short, as the bright part of the tail had been darkened in the vicinity of the star, the dark part was brightened, at least so much of it as was on the side furthest from the nucleus."

MÜNSTER. HEIS. (*Astron. Nachrichten*, 1169, p. 270.)

"Das Ende des Schweifes reichte bis an die Sterne θ, ι, $\varkappa$ Boötis. Die Breite des Schweifes betrug in der Mitte 7 – 8 Grade."

A drawing of the tail is contained on a chart communicated by Dr. Heis.

VIENNA. HORNSTEIN AND WEISS. (*Annalen der Wiener Sternwarte*, F. III., IX. p. 180.)

"Der Ostrand des Schweifes bog sich von α über ϱ und γ nach θ Boötis, bis zu welchem Sterne hin das Ende des Schweifes reichte. Gesammtlänge des Schweifes: 32 bis 33 Grade."

The following is the earliest notice of the columnar structure of the more remote part of the tail. Its character will be best understood by reference to Plates. The reader is also referred to a special notice of this feature in a subsequent part of this volume.

DORPAT. LAIS. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. p. 57.)

"Um 9^h 30^m mittl. Zeit bedeckte der Schweif des Cometen Arctur, und reichte bis $\varkappa$ Boötis, während der Kopf etwa $1\frac{1}{2}°$ südlich von Arctur stand, so dass die Ausdehnung des Cometen in Declination (18° bis 54°) = 36° betrug. Die Krümmung des Bogens wird immer stärker und gegen das Ende breitet sich der Schweif auf seiner verwaschenen Seite federartig aus, indem man sogar einzelne hellere Strahlen wahrnehmen konnte. Der schwarze Spalt in der Mitte des Schweifes, der unmittelbar am Kerne beginnt, ist weit auffallender und länger geworden."

DORPAT. MÄDLER. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. p. 45.)

"Die convexe Seite des gekrümmten Schweifes ist weit bestimmter begrenzt als die concave, und beide sind durch einen (nicht ganz dunklen) Spalt bis auf 3° Länge getrennt. Das Ende des Schweifes reicht bis in die Nähe von α Draconis.

Arctur trat noch vor dem Untergange in den Schweif, und zwar in dessen lichtesten Theil, doch ohne weder an Glanz noch an Farbe zu verlieren."

ALTONA. PAPE. (*Astron. Nachrichten,* 1172, pp. 315, 317, and 1173, pp. 337, 338.)

"Die beiden Schweifäste waren durchaus nicht mehr scharf begrenzt, die dunkle Zone zwischen beiden heller als früher und die Neigung beider Aeste gegen einander war seit Octbr. 2 entschieden stärker geworden. . . . . . Oct. 5 war eine kleine Unebenheit in der Krümmung nicht zu verkennen, die seitdem täglich zunahm und daraus entstand, dass die Grenzlinie vom Cometenkern anfänglich fast gradlinig fortging in etwa 8° Entfernung aber mit einer erheblichen Krümmung nach rechts hin abbog und dann eine der bisherigen Grenze etwa parallele Curve beschrieb. . . . . .

"Beobachtete Puncte im vorangehenden Schweifrande:

M. B. Z.	α 1858.0	δ 1858.0	α ☄	δ ☄
Octbr. 5.333	219° 26′	+35° 55′	212° 6′	+19° 39′
5.333	217 55	+50 25		

"Beobachtete Puncte im nachfolgenden Schweifrande:

M. B. Z.	α 1858.0	δ 1858.0
Octbr. 5.333	211° 55′	+35° 55′ "

A lithograph of the position of the tail among the stars accompanies the above.

CLINTON, N. Y. OBSERVATORY OF HAMILTON COLLEGE. PETERS. (*Communicated in Mss.*)

"The dark hollow of the tail seemed to have a parabolic outline, the nucleus being at the apex, and the parameter being about equal to the breadth of the inner corona. The light within it decreased towards the centre, at first abruptly, and then slowly. The left side was less distinct than the right."

GENEVA. PLANTAMOUR. (*Note sur la Comète de Donati,* p. 11.)

"La comète étant placée à 212°.1 ascension droite et +19°.7 déclinaison, j'ai noté la trace de la queue près des étoiles suivantes:

	Ascension droite.	Déclinaison.
ρ Bouvier	217°	+30°
γ Bouvier	217	+39
θ Bouvier	213.5	+52

"Avant d'atteindre θ Bouvier, la queue s'épanouissait, surtout à l'ouest, sur un espace assez considérable, dont j'estimais la limite la plus éloignée de la comète à 212° ascension droite et +60° déclinaison; elle avait ainsi plus de 40° de longueur. Si on calcule la position de points situés sur le prolongement du rayon vecteur, à des distances de plus en plus grandes, on trouve:

		Ascension droite.	Déclinaison.
Comète, rayon vecteur	0.59	212°.1	+19°.7
1er point sur le prolongement	0.69	219 .1	+26 .4
2me idem	0.79	228 .0	+33 .6
3me idem	0.89	238 .9	+40 .2
4me idem	0.99	251 .5	+45 .6

" Le prolongement du rayon vecteur se projette ainsi sur la sphère céleste suivant un arc, qui fait un angle de 42° avec l'arc qui joint la comète avec l'extrémité de la queue, mais en raison de la courbure de celle-ci, cet angle n'est que d'une vingtaine de degrés, si on prend la partie de la queue la plus rapprochée de la comète. L'arc sur la sphère céleste correspondant à un prolongement du rayon vecteur de 0.4 est de 41°.4 ; on peut donc en conclure, la longueur apparente de la queue étant à peu près la même, que la longueur linéaire de celle-ci était égale à 0.4, soit 13.5 millions de lieues (la lieue de 25 au degré)."

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 262.)

" Ganz unerwartet zertheilte sich gegen 6^h 45^m das Gewölk in so weit, dass man den Kopf des Kometen und α Boötis sehr gut sehen konnte; der Stern stand noch ausserhalb dem Bereiche des Schweifes."

VIENNA. SCHMIDT. (*Communicated in Mss.*)

" Länge des Schweifes für das blosse Auge = 37° (sehr klar).
Grösste Breite des Schweifes = 5°."

ALBANY, NEW YORK. SEARLE AND TOOMER. (*Astron. Journal*, No. 127, p. 51, and 119, p. 183.)

" Front edge of the tail:

Wash. m. s. t.	α	δ
Oct. 5.310	215° 40′	+23° 0′
5.310	218 25	29 20
5.310	221 0	+38 30

" Length of tail 22°; max. breadth 5°. Toomer.
" " 27 ; " " 6 . Searle."

OXFORD, ENG. SLATTER. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 24.)

" The tail more curved, like a bright plume sweeping upwards, with Arcturus enveloped near the head, enclosing γ Boötis, central at the widest part, and λ Boötis just at its boundary, the tip reaching to the triangle formed by θ, ι, $\varkappa$ Boötis. This was the fullest size it attained."

AYLESBURY. SMYTH. (*Cycle of Celestial Objects continued at the Hartwell Observatory to* 1859.)

A sketch of the tail.

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 9.)

"Der dunkle Zwischenraum zwischen den beiden Schweifhälften ist heute erheblich breiter als Sept. 30, aber an den Rändern mehr verwaschen und theilweise mit Nebelmaterie gefüllt. Er beginnt gleich beim Kerne und schliesst sich fast der ganzen Breite nach an die nördliche Begränzung des Fächers an. Seine mittlere Richtung wurde an der vorangehenden Seite zu 33°.0, an der nachfolgenden zu 38°.5 gemessen.

"Die Breite des Cometen betrug, in 5 Minuten Abstand vom Kern, ungefähr 6′, von welchen 1′.5 auf die vorangehende Schweifhälfte, 1′.5 auf den dunklen Zwischenraum und 3′.0 auf die nachfolgende Schweifhälfte kommen.

"Auch dem blossen Auge erschien heute die vorangehende Seite des Schweifs viel verwaschener wie früher. . . . . .

"Der Hauptschweif erstreckte sich auch heute über θ Boötis hinaus und hatte an seinem Ende eine Breite, die dem Abstande von ε bis ζ Ursæ Maj. gleich kam, also mindestens von 4°."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 32.)

"Breite des Schweifes im Heliom. Abstand vom Kerne :	5′	Breite :	5′.5
" " "	13′	"	8′
" " "	26′	"	14′

"Der dunkle Raum in der Mitte des Schweifes war bedeutend breiter geworden; er schloss sich, wie immer, unmittelbar an den Kern an. Mit blossem Auge gesehen, gewährte der Comet einen überaus prachtvollen Anblick. Der gelbliche, starkgekrümmte Hauptschweif war bis etwa einen Grad über die Sterne θ, ι, $\varkappa$ Boötis zu verfolgen und ging durch diese Gruppe, so dass seine Länge in gerader Linie gemessen, über 34° betrug. . . . . .

"Die Helligkeit des Hauptschweifes löschte sein mattes Licht auf 1° – 2° Abstand von ihm, aus."

The following description of the peculiar aspect of the tail, elsewhere described as a deflection from its regular curve, deserves attention. It was repeatedly noticed at the Observatory of Harvard College, and allusions more or less explicit are made to the same phenomenon by Heis, Lais, Jeanjaquet, Plantamour, and others. The figures drawn at Markree, at the Collegio Romano, and at the Observatory of Harvard College, on the 8th of October, are all strongly characterized by this feature.

TRETIRE, ENG. WEBB. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 23.)

"To the naked eye there was a remarkable irregularity in the curve of the tail, which gave strongly the impression of the exhaustion, beyond a certain

distance, of the projectile or repulsive force, and of a consequent diffusion and dispersion of the luminous material. This was first noticed on the evening of the transit (Oct. 5th), when the train extended in a regular curve as far as σ and ϱ Boötis, which were near its centre; but about one third of the distance between ϱ and γ, where the tail attained its greatest width, the convexity began to be a little deflected backwards or flattened off. October 8 this was still more conspicuous."

Kingston, Canada West. Williamson. (*Canadian Journal*, Vol. III. p. 486.)

"The head was about a degree southeast of Arcturus, with a tail of about 32°, which was nearly its maximum length."

The aspect of the Comet to the naked eye on October 5th is represented on Plate XIII. Plate XIV. shows the relative intensity and character of the two branches of the tail at larger distances from the nucleus than could be comprised within the limits of one of the telescopic views. The fainter branch is scarcely so diffuse as it should have been represented, and the tail near the head is rather too narrow. The outlines of the tail and the secondary tails will be found on Plates XXVI. Section II. and XXIV. The telescopic view is represented on Plate XXXVII.

1858. October 6. (Plates XV., XXIV., XXVI. Section II., and XXXVIII.)

Göttingen. Auwers. (*Astron. Nachrichten*, 1167, p. 236.)

"Hauptschweif 34°."

Observatory of Harvard College. G. P. Bond.

"Tail extends 50° reaching to α Draconis, 7° broad." A sketch shows the peculiar columnar structure, or alternation of bright streaks with intermediate darkness, in the more remote part of the tail, noticed also by Lais at Dorpat on the 5th, and subsequently at other places. The "streamers" are first indicated in the sketch at a point where there is an abrupt bending backward of the front edge, about 22° from the nucleus.

Breslau. Galle. (*Astron. Nachrichten*, 1179, p. 40.)

"Die linke scharf begrenzte Seite des Schweifes ging links bei ε Boötis (um $\frac{1}{2}$ $\varepsilon - \sigma$ entfernt) vorüber und endigte zwischen δ und β Boötis, näher an β. Die rechte Seite endigte in der Gegend von σ Boötis mit der Richtung auf γ Boötis."

Münster. Heis. (*Astron. Nachrichten*, 1169, p. 270.)

"Der Schweif reichte bis über die Sterne θ, ι, $\varkappa$ Boötis hinaus und erreichte an diesem Tage das Maximum der Länge. Die Luft war ungemein heiter. Die Lichtstärke des Schweifes war im ersten Drittel ungemein gross, dann nahm sie plötzlich ab. Im letzten Drittel bei β und γ Boötis kam sie der Lichtstärke der Milchstrasse im Sobieskischen Schilde und im Schwan gleich, von da glich sie dem

Schimmer der Milchstrasse an ihren schwächern Theilen oder auch dem Scheine des Zodiacallichtes. An diesem Abende bemerkte ich ganz deutlich, was mir schon seit Anfang des Monats aufgefallen war, dass die äussere convexe Seite des Schweifes in der Begrenzungscurve gleichsam einen Bruch, einen Knick zeigte, gleichsam als habe sich vom dem Schweife irgend ein Theil gelös't, der stärker hervortrete. Diese Stelle fand ich am 6ten deutlich zwischen δ und ε Boötis bei 220° Rectascension und +31° Declination, etwa in der Mitte der Curve. Diese Anomalie der Begrenzungscurve bemerkte ich zwar noch am 8ten September[?] am 9ten aber war sie verschwunden."

A manuscript Chart of the tail with the neighboring stars has also been communicated.

Neuchatel. Jeanjaquet. (*Souvenirs de la Comète de* 1858, p. 15.)

"Contemplée à l'œil nu, la mystérieuse apparition offre ce soir quelquechose de bien curieux: sa pointe, au lieu de suivre la direction générale de l'astre vers le couchant, détourne vers le nord. . . . . . J'estime qu'elle peut avoir de 32 à 35 degrés de longueur, le sommet du panache, au moment ou le noyau touche l'horizon, allant se perdre parmi les étoiles les plus septentrionales du Bouvier, sur le prolongement des étoiles Zeta et Eta [?] de la couronne boréale." [θ, ι, and $\varkappa$ Boötis are probably intended.]

Dorpat. Lais. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. p. 58.)

"Der Schweif sehr ausgebreitet, etwa in der Mitte, bei ε Boötis am breitesten und um vieles heller, zeigt schon c. 6° von seinem Kopfe die federförmigen Strahlen sehr bestimmt. Heute hat der Comet den schönsten Anblick, indem sein Schweif zugleich die grösste Ausdehnung erreicht hatte.

"Derselbe reichte von π Boötis über $\varkappa$ Boötis entschieden hinaus ohne jedoch α Draconis zu erreichen, war also von (17° bis 60°) mindestens 43° lang. Die helle convexe Seite ist nicht mehr so scharf wie früher, sondern zeigt verwaschene Ränder, wodurch der helle Bogen des Schweifes näher zum dunklen Spalt zückt, der nicht nur an Länge, sondern auch an Breite zugenommen hat."

Altona. Pape. (*Astron. Nachrichten*, 1173, pp. 337, 338; 1174, p. 341.)

"Beobachtete Puncte im vorangehenden Schweifrande:

M. B. Z.	α 1858.0	δ 1858.0	α ☄	δ ☄
Oct. 6.326	223° 21′	+28° 55′	215° 12′	+16° 48′
6.326	224 29	+48 26		

"Beobachtete Puncte im nachfolgenden Schweifrande:

	α 1858.0	δ 1858.0
Oct. 6.326	216° 11′	+31° 55′ "

PLATE XV

G.P. Bond Del.

J.W. Watts Sc.

COMET OF DONATI 1858.

OCTOBER 6th 7h M.S.T. OBSERVATORY OF HARVARD COLLEGE.

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"Am 6. Oct. war der Himmel nur theilweise klar, und der Schweif des Cometen abwechselnd von Wolken verdeckt, so dass ich ihn nur in einzelnen Momenten einigermaassen deutlich sah. Ich habe an diesem Tage mehrere Grenzcurven eingetragen, die jedoch unter sich über einen Grad abweichen, und habe zur Erlangung der schliesslichen Positionen das Mittel genommen. Man sieht also, dass die Angaben für diesen Tag mit erheblicher Unsicherheit behaftet sind."

ALBANY, NEW YORK. SEARLE AND TOOMER. (*Astron. Journal*, No. 127, p. 51.)

Wash. m. s. t.	α	δ
Oct. 6.310	221° 30′	+24° 30′
6.310	225 20	35 0

OBSERVATORY OF HARVARD COLLEGE. TUTTLE.

"Tail 50° long, and very much diffused beyond 10° from the nucleus."

A sketch shows the deflection in the front curve at a point about 25° from the nucleus where the outline was broken by the "streamers." One of the rays appears to be the same with the new secondary tail seen on the preceding evening.

VIENNA. . . . . . (*Annalen der Wiener Sternwarte*, F. III., IX. p. 180.)

"Am 6 October streifte der Ostrand des Schweifes die Sterne ε und β Boötis, und endete in der Nähe von ι Boötis. Bis zum Sterne ε Boötis war ein heller Streifen am östlichen Rande des Schweifes zu verfolgen, welcher nahe die Gestalt einer langgestreckten Ellipse hatte."

Plate XV. gives the naked-eye view of the Comet on October 6th; Plates XXVI. Section II. and XXIV., the outlines of the tail and the secondary tails; Plate XXXVIII., the telescopic view.

1858. October 7. (Plates XVI., XXIV., and XXVI. Section II.)

MARKREE. COOPER. (*Obs. of Donati's Comet* 1858, *Markree*, p. 11.)

"(7^h 30^m m. s. t.) The tangent to the tail at the nucleus, on the eastern or following side, runs through δ Cor. Bor. Where the east side of the tail forms an isosceles triangle with Arcturus and Mirac (ε Boötis), the tangent runs through β and θ Cor. Bor., subsequently that side touches η Cor. Bor. . . . . .

"As usual the east side of the tail was decidedly brighter than the other; the tail itself was about 40° in length. In the continuation of the axis, it extended farthest."

MÜNSTER. HEIS. (*Astron. Nachrichten*, 1179, p. 40.)

"Der Schweif erstreckte sich mit der linken, scharf begrenzten Seite bis in die Mitte zwischen β Coronæ und δ Boötis. Rechts endigte derselbe unweit ε Boötis, um $\frac{1}{3}$ $\sigma\varepsilon$ links von diesem Stern."

VIENNA. HORNSTEIN AND WEISS. (*Annalen der Wiener Sternwarte*, F. III., IX. pp. 180, 181.)

"Die Breite des zwischen beiden Schweifästen befindlichen dunklen Raumes hatte zugenommen; allein dieser ganze Raum schien etwas heller und mit Lichtmaterie erfüllt zu sein. Ueberhaupt erschienen alle Partien des Schweifes mehr gleichmässig verwaschen als an den vorhergehenden Tagen; selbst in der Nähe des Kernes war dieser Umstand deutlich zu beobachten. Das diffuse Licht um den Kopf des Cometen war stärker als früher. Der rechte (vorangehende) Ast hatte (um $20^h\ 19^m$ Sternzeit) eine Ausbiegung nach aussen im Parallelkreise von $+14°\ 9'$. Um $19^h\ 55^m\ 48^s$ Sternzeit stand der an diesem Tage zur Ortsbestimmung des Cometen benützte Vergleichstern, um $20^h\ 11^m$ Sternzeit der Stern Lal. 26738, 26740, $\alpha = 14^h\ 33^m\ 54^s$, $\delta = +14°\ 9'$ in der Mitte des dunklen Raumes zwischen den Schweifästen. Der Kern hatte an Intensität zugenommen, aber die fächerartige Form beibehalten. Die Länge und Breite des Schweifes hatte beträchtlich zugenommen; der Ostrand streifte η Coronæ und μ Boötis, bog sich dann zurück, war aber noch weit über β Boötis hinaus zu verfolgen, während der Westrand sich nach ξ Boötis hin wendete. Für die Position der helleren Schweifpartien waren folgende Messungen erhalten worden: —

Mittlere Wiener Zeit: $8^h\ 15^m$; Position des Kernes: $\alpha\ 14^h\ 33^m\ 21^s$, $\delta\ +13°\ 42'$.

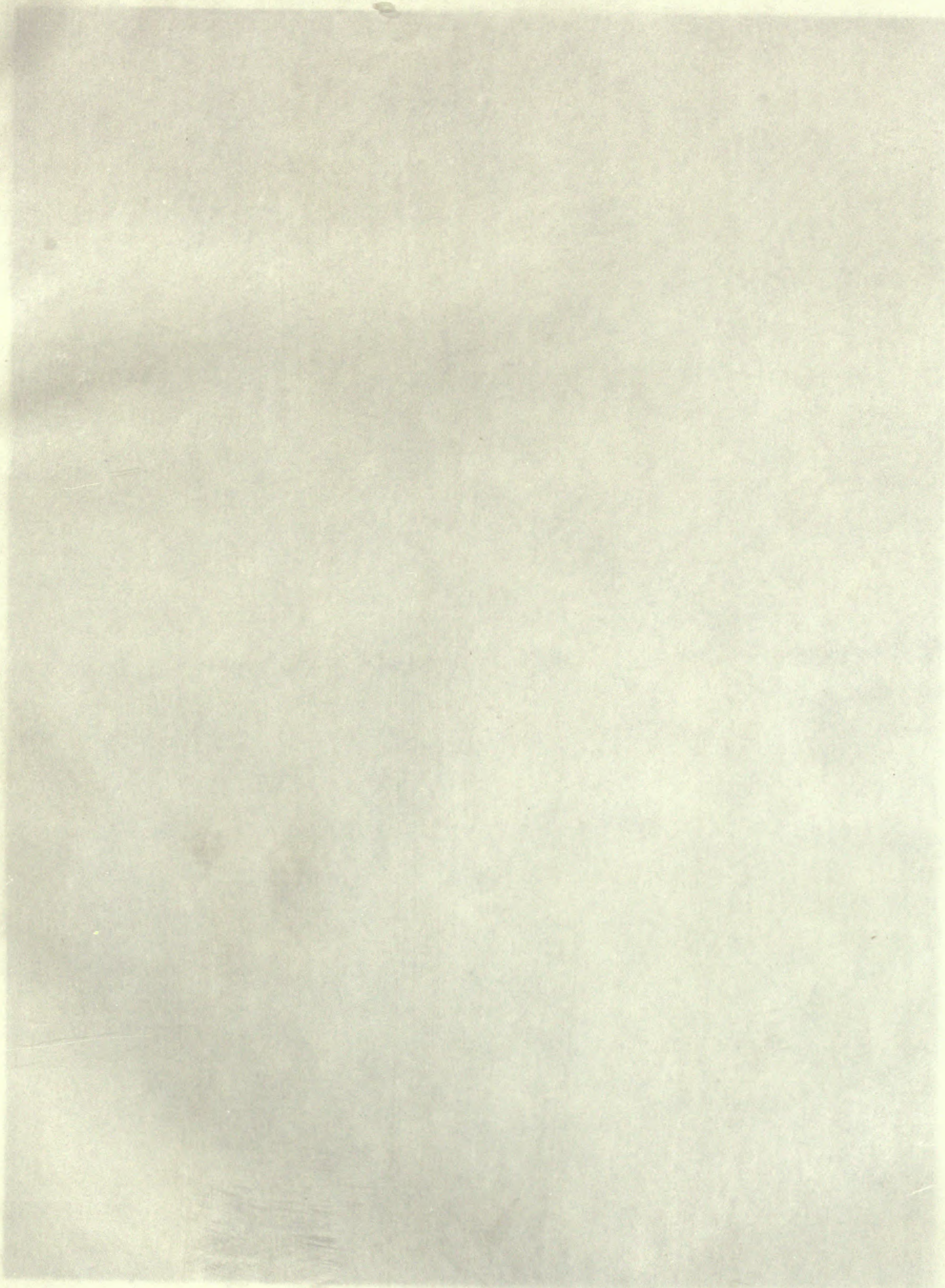
	$\delta\ +13°\ 53'$	$\delta\ +14°\ 8'$	$\delta\ +15°\ 1'$	$\delta\ +15°\ 32'$
	h m s	h m s		
Westlicher Ast, Westlicher Rand .	α 14 33 44	α 14 34 21		
" " Hellste Linie . .	33 55	34 39		
" " Oestlicher Rand . .	34 4	34 56		
Oestlicher Ast, Westlicher Rand . .	34 15	35 12		
" " Hellste Linie . . .	34 40	35 32	h m s	h m s
" " Oestlicher Rand . .	35 2	36 0	14 39 23	14 41 22
Hieraus folgt:				
Breite des ganzen Schweifes senkrecht auf seine Längenrichtung . . .	12'.0	15'.2		

NEUCHATEL. JEANJAQUET. (*Souvenirs de la Comète de* 1858, p. 16.)

"A la vue simple, la comète se présente avec la même particularité que hier, détournement de la pointe vers le nord. La partie supérieure du panache témoigne à son tour de cette singularité; il semble qu'un grand vent la fouette et la force à s'incliner aussi vers le pôle."

DORPAT. LAIS. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. p. 58.)

"Der dunkle Spalt ist noch länger und breiter geworden. Zugleich bildet der Schweif nicht mehr wie früher an der hellsten Seite einen vollkommen begrenzten Bogen, sondern der schon am vorhergehenden Abende verwaschen erscheinende Rand zeigt gleich der mattern Seite entschieden federförmige Ausstrahlungen, die



[illegible] (Annalen der Wiener Sternwarte.) [illegible]

[illegible] Breite der zwischen beiden Schweifästen [illegible] sehr zugenommen; allein dieser ganze Raum [illegible] erfüllt zu sein. Ueberhaupt [illegible] nicht gleichmässig [illegible] als an den vorhergehenden [illegible] der Nähe des Kernes [illegible] [illegible] um den Kern [illegible] war [illegible] Ast hatte [illegible] eine [illegible] [illegible] Vergleichstern [illegible] 26738, [illegible] zwischen den [illegible] Der Kern hatte [illegible] fächerartige [illegible] Die Länge [illegible] zuge- nommen. Der [illegible] streifte [illegible] dann zurück, war [illegible] über β Boötis [illegible] der Westrand sich [illegible] Boötis hin wendete. [illegible] Schweifpartien waren folgende Messungen erhalten [illegible]

Mittlere Wiener Zeit: 8 [illegible] δ +13° 42′.

[illegible] δ +15° 32′

Westlicher Ast. Westlicher Rand	[illegible]	[illegible]	[illegible]
" " Hellste Linie	[illegible]	[illegible]	[illegible]
" " Oestlicher Rand	[illegible]	[illegible]	[illegible]
Oestlicher Ast. Westlicher Rand	[illegible]	[illegible]	[illegible]
" " Hellste Linie	[illegible]	[illegible]	[illegible]
" " Oestlicher Rand	[illegible]	[illegible]	[illegible]

Hieraus folgt:

Breite des ganzen Schweifes [illegible]

[illegible]

[illegible] hier, [illegible] panache té- [illegible] la fouette et [illegible]

[illegible] geworden. Zugleich bildet der [illegible] einen vollkommen begrenzten Bogen [illegible] fliessende verwaschen erscheinende Rand [illegible] federförmige [illegible], die

PLATE XVI

G.P.Bond Del.

J.W.Watts Sc

COMET OF DONATI 1858.

OCTOBER 7th 7h M.S.T. OBSERVATORY OF HARVARD COLLEGE

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am breitesten und deutlichsten in der Nähe der Krone sind. Die convexe Bogengestalt jedoch ist sehr regelmässig, durch ihre grosse Helligkeit bis an das Schweifende zu verfolgen, wodurch dieser Bogen, der in seiner Krümmung einen vollen Quadranten bildet, mit dem Kiel einer Feder zu vergleichen war, deren Fahnen auf der einen Seite breiter als auf der andern ist. Der Schweif endet etwas südlich von ι Draconis, so dass der Comet etwa von ζ Boötis (20°)* bis ι Draconis (58°) sich erstreckend, eine scheinbare Länge von 38° in Declination hatte."*

Dorpat. Mädler. (*Beob. Kaiserl. Sternw. Dorpat,* Vol. XV. p. 46.)

"Die Spalte im Schweif ist breiter geworden."

Kremsmünster. Reslhuber. (*Astron. Nachrichten,* 1169, pp. 263, 264.)

"Schweif ist stark gekrümmt, bei 44 Grade lang, an der breitesten Stelle bei 10 Grade breit; die Krümmung auf der convexen (westlichen) Seite regelmässig, der Rand gut begrenzt und hell; auf der concaven Seite ist alles mehr verwaschen, die Lichtintensität viel geringer; in $\frac{1}{3}$ der Länge Entfernung vom Kerne verbreitet sich die Schweifmaterie in so auffallender Weise, gleichsam als könnten bei seiner schnellen Vorwärtsbewegung die entfernteren feinen Theilchen des Schweifes nicht schnell genug nachfolgen."

Vienna. Schmidt. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge = 46° (sehr klar).
Grösste Breite des Schweifes = 8°."

Poulkova. O. Struve. (*Pulk. Beob. des Grossen Cometen* 1858, p. 11.)

"Für den dunklen Zwischenraum zwischen den beiden Schweifhälften, der jetzt viel breiter geworden, aber zum Theil mit Nebelmaterie gefüllt ist, wurde gefunden: —

Richtung der vorangehenden Seite	35°.0
" " nachfolgenden "	50 .0

Diese Richtungen sind die mittleren bis etwa 6′ Abstand vom Kern.

"Mit blossem Auge wurden noch folgende Beobachtungen über den Schweif hinzugefügt. Der Nebenschweif ging einen halben Grad nördlich bei α Coronæ vorbei und erstreckte sich durch das ganze Sternbild der Corona. Die Breite des Hauptschweifs ist in der Höhe von α Coronæ gleich dem Abstande zwischen ι und θ Coronæ oder nahezu 6°. Die letzten Spuren des Hauptschweifs lassen sich verfolgen bis etwa 2° jenseits ι Draconis."

Poulkova. Winnecke. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 32, 33.)

"Der helle Schweif endete erst einen Grad jenseits κ und ι Boötis, die in ihm

* The declination of ζ Boötis is +14° 20′. The length of the tail by this observation is about 47°.

standen, war also über 40° lang. ψ Herculis und β Boötis standen gleichzeitig in ihm, so dass seine Breite in 27° Abstand vom Kopfe 8° – 9° betrug." *

The view of the Comet to the naked eye on October 7th is given on Plate XVI.; the outlines of the tail and the secondary tails, on Plates XXVI. Section II., and XXIV.

Observations upon the deflection of the tail are most numerous on the 8th. Its decided character was soon after lost in the increasing diffusion and faintness of the Comet.

1858. October 8. (Plates XVII., XXIV., XXV., $XXV_{(a)}$, XXVI. Section II., and XXXIX.)

OBSERVATORY OF HARVARD COLLEGE. W. C. BOND.

" 7^h 30^m m. s. t. The radius of curvature of the brightest part of the tail is about 40°. The light I trace steadily 7° beyond α Coronæ. There is an evident increase of length and breadth. At the outer part it must be 7° to 10° broad."

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"To the naked eye the tail presented a very curious division into bands (at a point indicated in a sketch, Plate $XXV_{(a)}$), above and to the left [?] of Corona Borealis, — five or six could be distinguished, half a degree or less in breadth, with clear, well-defined outlines, and perfectly resembling auroral streamers, excepting that they kept their position permanently, that is, without motion sensible to the eye: they diverged from a point between the sun and the nucleus. Tail sweeps faint as far as a point vertically over Mizar. This gives the length 52°."

OBSERVATORY OF HARVARD COLLEGE. R. F. BOND.

A sketch of the Comet exhibiting the light and dark bands, and the deflection of the curve in the upper part, Plate $XXV_{(a)}$.

CAMBRIDGE, ENG. CHALLIS. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 19.)

"To the naked eye the tail appeared more diffused than on October 5, especially at its extremity. The greatest apparent curvature was at the distance from the nucleus of one fourth its length. The length was but little diminished.

MARKREE. COOPER AND GRAHAM. (*Obs. of Donati's Comet* 1858, *Markree*, p. 12.)

" 7^h 45^m m. s. t. A very satisfactory drawing of the entire object, as seen with the naked eye, was made about a quarter to eight o'clock, on Argelander's Atlas. It could be faintly traced to the line joining α Cor. Bor. and ψ Boötis, from a little eastward of the former to about the same distance eastward of the latter; upward from thence it gradually diminished, slightly concave on the east side, nearly straight on the west, until the boundary lines ended respectively in χ and ψ Herculis. Thus the eastern or following boundary of the tail was convex from the nucleus to α

* The distance from β Boötis to ψ Herculis (ν_1 and ν_2 Boötis) is 5° 40′.

[illegible] β Boötis standen [illegible] [illegible] betrug." *

The [illegible] on October 7th is given on [illegible]; the [illegible] of the tail and the secondary tails, on Plates XXVI. [illegible] II, and [illegible].

[illegible] the [illegible] of the tail are most [illegible] on the 8th [illegible] was [illegible] lost in the increasing diffusion and faintness [illegible].

[illegible] (Plates XVII, XXIV, XXV, [illegible], XXVI. Section II, and XXXIX.)

[illegible] W. C. Bond.

[illegible] The radius of curvature of the brightest part of the tail is [illegible] beyond α Coronæ. There is an evident [illegible] of length and breadth. At the outer part it [illegible] to 10° broad."

[illegible] G. P. Bond.

[illegible] the tail presented a very curious [illegible] at a [illegible] above and to the [illegible] of Corona [illegible] half a degree or less in breadth, with [illegible] auroral streamers, excepting [illegible] without motion sensible to the [illegible] the sun and the nucleus. Tail sweeps [illegible] This gives the length 52°."

[illegible]

[illegible] the light and dark bands, and the deflection [illegible]

[illegible] Notices Royal Astr. Soc., Vol. XIX. p. 19.)

[illegible] appeared more diffused than on October [illegible] apparent curvature was at [illegible] the [illegible] length. The length was but [illegible]

[illegible] (Obs. of Donati's Comet [illegible])

[illegible] A very satisfactory drawing of [illegible] seen with the naked eye, was made about a quarter to [illegible] Atlas. It could be faintly traced to the line joining [illegible] Bootis, from a little eastward of the former to about the same [illegible] of the latter; upward from thence it gradually diminished, [illegible] east side, nearly straight on the west, until the boundary lines [illegible] χ and ψ Herculis. Thus the eastern or following boundary of the tail was convex from the nucleus to α

* The distance from β Boötis to [illegible] is [illegible].

PLATE XVII.

G.P.Bond Del.

J.W.Watts Sc.

COMET OF DONATI 1858.

OCTOBER 8TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE.

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Cor. Bor.; thence to χ Herculis it was slightly concave; the western boundary was concave from the nucleus to ψ Boötis; thence to ψ Herculis nearly straight. Southeast of the line joining α Cor. Bor. and ζ Boötis, the tail was very decidedly brighter than on the other side of this line, the change in the intensity of light being abrupt and remarkable; in fact, the brighter portion of the tail ended nearly in a point at α Cor. Bor. Its northwestern boundary was slightly concave. When closely scrutinized, the whole Comet had very much the appearance of a bird's wing. According to the above, the length of the tail was about 33°, its breadth, at the widest, 6°.7. We omitted to mention that the tail, near the nucleus, consisted, as heretofore, of two streams of light, leaving a dark, parabolic space in the centre, with the nucleus at its vertex."

A valuable chart accompanies the above, in which the character of the deflection of the upper portion of the tail is clearly marked, as will be seen in the tracing on Plate $XXV_{(a)}$.

Mr. Cooper has communicated to me a more particular account of the separation between the brighter and fainter portions of the tail; he describes it as quite sharp, the boundary being very nearly in a straight line from α Coronæ to ζ Boötis.

OBSERVATORY OF HARVARD COLLEGE. FETTE.

Drawing of the Comet and stars near it. The outlines are given on Plate $XXV_{(a)}$.

BRESLAU. GALLE. (*Astron. Nachrichten*, 1179, pp. 40, 41.)

"Es konnten nur in der Dämmerung einige Beobachtungen gemacht werden, indem der Himmel sich bald nachher bewölkte. Der Schweif endete etwas links von Gemma."

LIVERPOOL. HARTNUP. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 56.)

"Length of tail 35. Greatest diameter 7° 30′.

"Distance from centre of nucleus to front of coma . . . . = 3′ 36″

"Diameter of coma at right angles to tail measured through centre of nucleus . . . . = 8′ 46″"

MÜNSTER. HEIS. (*Astron. Nachrichten*, 1169, p. 270.)

"Hatte sich der Schweif, obgleich der Himmel heiter war, gegen die vorhergehenden Tage ungemein verkürzt. Er reichte nur bis zu φ, μ, ν Boötis."

A manuscript chart of the tail and neighboring stars has been communicated by Prof. Heis.

DORPAT. LAIS. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. p. 58.)

"Die federförmige Ausstrahlung auf der W. Seite ist noch deutlicher geworden und die Breite des ganzen Schweifes hat noch zugenommen, während der helle

Bogen in den beiden federförmigen Ausstrahlungen, keine regelmässig fortlaufende Krümmung zeigt, sondern etwa auf $\frac{1}{5}$ der Länge eine auffallende Biegung macht. Der dunkle Spalt ist sehr augenfällig, und kann weit über die halbe Länge des Schweifes hinaus verfolgt werden."

BATAVIA. OUDEMANS. (*Astron. Nachrichten,* 1183, p. 107.)

"Schweif 16° Länge."

ALTONA. PAPE. (*Astron. Nachrichten,* 1172, p. 317; 1173, p. 337; 1174, p. 341.)

"Traten heute einige feine Streifen säulenartig aus der Begrenzung des Schweifes hervor. Ihre Richtung machte mit der vorangehenden Schweifgrenze einen Winkel von etwa 10°."

"Beobachtete Puncte im vorangehenden Schweifrande: —

M. B. Z.	α 1858.0	δ 1858.0	α ☄	δ ☄
Oct. 8.319	232° 10′	+25° 26′	221° 27′	+10° 30′
8.319	235 54	+42 51"		

"Die Beobachtungen des 8 October sind aus einem andern Grunde unsicher. Ich habe schon § 1 in der Beschreibung der Erscheinungen erwähnt, dass ich an diesem Tage zuerst den vorangehenden Rand verwaschen, gewissermassen ausgezackt, gesehen habe. Die hiedurch hervorgebrachte Unsicherheit der Grenzen, verbunden mit der grossen Lichtschwäche des Schweifes in seinen oberen Theilen, macht mir die starken Abweichungen dieses Tages hinreichend erklärlich."

MADRAS. POWELL. (*Monthly Notices Royal Astr. Soc.,* Vol. XIX. p. 65.)

"Outline of envelope ragged, the tail reaching a little beyond α Coronæ Borealis. On the lower side the light shades off almost imperceptibly; on the upper, though ragged, it terminates comparatively abruptly. The darkness down the envelope scarcely so clear as before. Nucleus about as bright as Mars or α Lyræ. The shape of the envelope bears a resemblance to a pen, being narrow at the head, and after a short space suddenly spreading on the lower side like the feather of a quill."

VIENNA. SCHMIDT. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge = 53° (sehr klar).
Grösste Breite des Schweifes = 15°.0."

ALBANY, NEW YORK. SEARLE AND TOOMER. (*Astron. Journal,* No. 127, p. 51.)

Wash. m. s. t.	α	δ
Oct. 8.275	228° 27′	16° 40′
8.275	230 35	20 40

COLLEGIO ROMANO. SECCHI. (*Mem. dell' Osserv. del Collegio Romano,* 1859, p. 15.)

"Si conserva pure all' osservatorio un disegno della cometa come era visibile

ad occhio nudo, ove si ebbe cura di far rilevare la forma curva dell' estremità della coda, e quella specie di materia sparsa che l' accompagnava, irregolarmente diffusa che si potrebbe credere affatto uscita dalla sfera d' attrazione della cometa e perduta.* Questa materia era sempre visibile dalla parte della curvatura interiore della coda la quale riusciva perciò mal terminata, mentre la esteriore era benissimo decisa; avuto riguardo alla sua posizione, resta assicurato che la parte più sfumata era dal lato che la cometa abbandonava col suo corso."

In a copy of the valuable drawing mentioned above, communicated by P. Secchi, the deflection has the same decided character which appears in the drawings at Markree and at the Observatory of Harvard College. For a tracing of the outline, see Plate $XXV_{(a)}$.

OXFORD. SLATTER. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 24.)

"Again to the naked eye a perceptible change, the head having become much brighter since the 5th. The tail also apparently more condensed on the brighter side, and much fainter in its upper part above α Coronæ."

TRETIRE, ENG. WEBB. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 23.)

"October 8, this (i. e. the deflection observed on the 5th) was still more conspicuous; the curve of the antecedent side, which was carried regularly up to α Coronæ, being subsequently deflected from the direction of δ Draconis, to which it had previously tended, towards a fresh point between ι and ζ Draconis, about one third of their distance from the latter star, as far as could be ascertained in making an estimate of so very dim an object; sometimes I thought that ζ Draconis was the point indicated. The fainter branch could not be well made out higher than ψ Boötis; beyond this star it seemed, if anything, to approximate again towards the other branch; and the general impression of this side of the tail was that of spreading out like a feather, as compared with the more definite aspect of the convex edge. The whole length on this evening could not have been less than 45°; the greatest breadth, as measured by α Coronæ and ψ Boötis, about 7°."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 33.)

"Die Zone im Innern des Schweifes ist heute bei weitem nicht mehr so dunkel als früher; an den Rändern des Schweifes und auf zwei bis drei Minuten Abstand von ihnen, ist die Helligkeit, wie immer, sehr viel grösser.

"Im Abstande vom Kerne 13′; Breite des Schweifes 13′.
" " " " 26′; " " " 15′.

"Der Schweif liess sich bis 2° über ψ Herculis hinaus verfolgen, woraus seine

* "Quel raggio retto e sottile che trovasi indicato da Bond ed altri, non fu veduto da noi."

Länge sich zu 35° ergiebt. In der Nähe von α Coronæ, das auf der linken Schweifgränze stand, also in 20° Entfernung vom Kerne, war der Schweif 7° breit. Höchst auffallend war die säulenartige Schichtung der obern Schweifpartien. Den zweiten Schweif konnte ich durchaus nicht wahrnehmen."

VIENNA. . . . . . (*Annalen der Wiener Sternwarte*, F. III., IX. p. 181.)

"Der Ostrand des Schweifes ging bei α, ζ, und μ Coronæ vorüber bis gegen ψ Boötis, während der Westrand sich bis χ Boötis ausbreitete."

The appearance of the Comet to the naked eye on October 8th is represented on Plate XVII.; the outlines of the tail, on Plate XXVI. Section II.; the secondary tails, on Plates XVII. and XXIV.; and the telescopic aspect, on Plate XXXIX. The position of the light-axis is given in a chart on Plate XXV. The outlines on Plate $\mathrm{XXV}_{(a)}$ have been traced from drawings made at Rome, Markree, and the Observatory of Harvard College.

1858. October 9. (Plates XVIII., XXIV., XXVI. Section III., and XL.)

GÖTTINGEN. AUWERS. (*Astron. Nachrichten*, 1167, p. 237.)

"Die grösste Länge des Hauptschweifs fand ich Octob. 9 = 41°."

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"The tail extends faintly 20° or more beyond Corona Borealis."

CAMBRIDGE, ENG. CHALLIS. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 19.)

"To the naked eye the tail was fainter and still more diffused than on October 8, but nearly of the same length."

OPORTO. PORTUGAL. BARON DE FORRESTER.

Sketch of Comet and stars in its neighborhood.

MÜNSTER. HEIS. (*Astron. Nachrichten*, 1169, pp. 270, 271.)

"War gleichfalls bei heiterer Witterung der Schweif nur bis zur obern Grenze der Krone sichtbar. Die am Kopfe des Cometen berührend an die äussere Begrenzungscurve gelegte Linie ging zwischen die Sterne α und δ Serpentis."

A manuscript Chart of the tail and neighboring stars has also been communicated.

SACRAMENTO. LOGAN. (*Astron. Journal*, No. 119, p. 184.)

"Tail 30° long."

DORPAT. LAIS. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. p. 58.)

"Der Schweif beginnt schon in der Nähe des Kopfes sich bedeutend auszubreiten und zeigt daher im weitern Verlauf eine alle bisherigen Erscheinungen übertreffende Breite. Das ganze Sternbild der Krone wurde an der breitesten Stelle nicht nur bedeckt, sondern sogar ein wenig überragt, so dass dieses Sternbild einen bequemen Massstab für die bedeutende Breite an diesem Tage abgab, die mindestens 10° betrug. Die federförmige Ausstrahlung der W. Seite war wieder

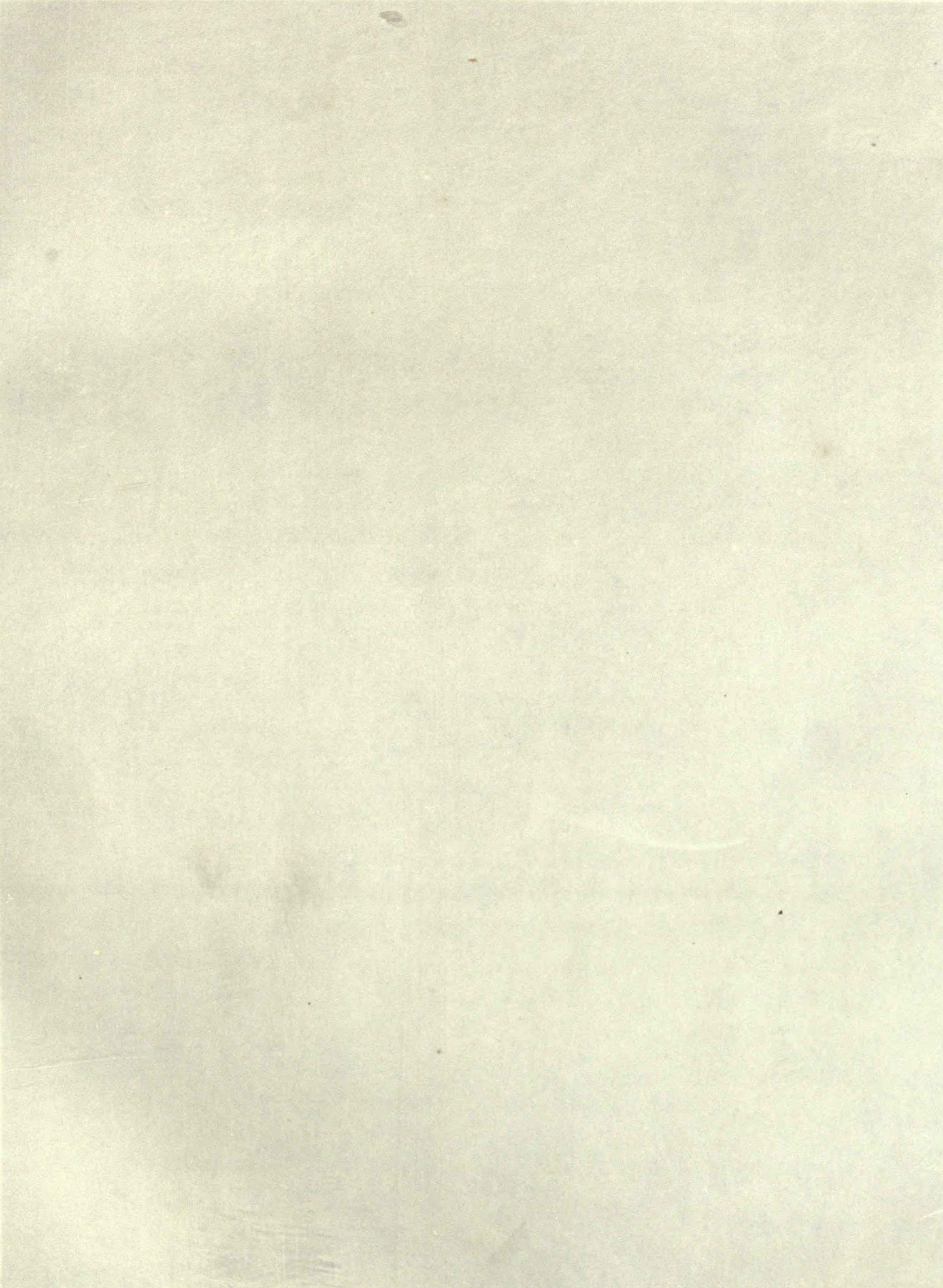


PLATE XVIII

G P Bond Del.

J.W. Watts Sc.

COMET OF DONATI 1858.

OCTOBER 9TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE.

Printed by Chas. D. Andrews

zum grossen Theil verschwunden, dafür bildete aber der hellste Theil des Schweifes, durch das besonders helle Licht desselben, gewissermassen eine für sich abgeschlossene garbenförmige Gestalt, mit der vielleicht die gestern beobachtete plötzliche Biegung in Zusammenhang steht, deren Spitze bis ε Coronæ reichte, und aus deren einer Seite die strahlenförmigen matten Theile des übrigen Schweifes herauszuschiessen schienen, dessen letzten matten Spuren in der Gegend von θ Draconis verschwanden."

This would give a length of 54°.

DORPAT. MÄDLER. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. p. 48.)

"Die dunkle Spalte im Schweife wird jetzt allabendlich breiter und augenfälliger."

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, p. 317, and 1174, pp. 342, 343.)

"Der Schweif gewähnte einen eigenthümlichen Anblick. In etwa 24° Abstand vom Kern, trat aus der vorangehenden convexen Seite eine helle Lichtsäule etwa 30′ links von ε Coronæ hervor, die ich mehrere Grade weit ausserhalb des Schweifes verfolgen konnte. Ihr Licht war heller als das der nächstgelegenen Schweiftheile, so dass man sie bis tief in den Schweif hinunter wahrnehmen konnte. Auf beiden Seiten war sie von ähnlichen, aber schwächern und kürzern Säulen umgeben, die auf der linken Seite die Grenze des Schweifes durchbrachen und ihr ein unregelmässiges Ansehen gaben, auf der rechten dagegen sich allmälig mit dem hellen Schweifgrunde vermischten, auf den sie sich projicirten. Der Schweif war hiedurch in zwei Theile getheilt, einen untern hellen und schmalen, und einen oberen sehr diffusen und ausgebreiteten. Der heutige Abend gewährte überhaupt die grossartigste Erscheinung des Schweifes, dessen äusserste, noch mit Mühe wahrnehmbare Grenze, der Rechnung zufolge, 50° eines grössten Kreises vom Kern entfernt war. . . . . .

"Der bislang scharfbegrenzte vorangehende Rand war in seinen mittleren Theilen am 9 Oct. von mehreren hellen Säulen durchbrochen, die sich in grösserer Ausdehnung über den unteren Theil des Schweifes verbreiteten und sich durch ihre Helligkeit von dem Grunde, auf dem sie lagen, deutlich abhoben. . . . . .

"Beobachtete Puncte im Schweif: —

M. B. Z.	α 1858.0	δ 1858.0	α ☄	δ ☄
Octbr. 9.288	244° 8′	+52° 57′	224° 27′	+7° 11′
	240 41	29 27		
	238 26	27 17		
	230 12	+18 37."		

A lithograph accompanies the above.

VIENNA. SCHMIDT. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge = 58° (sehr klar).
Grösste Breite des Schweifes = 12°.0."

ALBANY, NEW YORK. SEARLE AND TOOMER. (*Astron. Journal,* No. 119, p. 184; No. 127, p. 51.)

"Length of tail 33°. Searle.
" " 30; Breadth 10°. Toomer."

"The following are the positions of points on the front edge: —

Wash. m. s. t.	α	δ
Oct. 9.333	230° 0′	+10° 0′
9.333	235 35	18 35
9.333	239 30	+27 30"

OXFORD. SLATTER. (*Monthly Notices Royal Astr. Soc.,* Vol. XIX. p. 25.)

"The tail had greatly diminished in length, not reaching much, if at all, above α Cor. Bor."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 13.)

"In 5 Minuten Abstand vom Kern wurde die ganze Breite des Schweifs auf 6′ geschätzt. Von diesen kommen 1′.5 auf den vorangehenden hellen Theil, 2′ auf den dunkleren Streif, und 2′.5 auf den nachfolgenden hellen Theil. Der dunklere Streif ist sehr unbestimmt begränzt und viel mehr mit Nebelmaterie gefüllt, wie früher, daher auch keine Messungen über seine Richtung angestellt werden konnten.

"Um 20^h 40^m machte Lieutenant Smysloff mit blossem Auge eine sorgfältige Verzeichnung der Sterne, durch welche der Schweif passirte. In demselben waren besonders zwei dunklere Streifen auffallend, welche sich in der Nachbarschaft von α Coronæ zu einer Spitze vereinigten und nahe bei $\varkappa$ und ζ Coronæ vorbeigingen."

A lithograph accompanying the above shows the tail extending over θ and ι Draconis to a distance of above 55° from the nucleus.

HUNT'S CORNERS, NEW YORK. SWIFT. (*Astron. Journal,* No. 118, p. 176.)

"On the evening of the 9th instant I noticed what seemed to be a multiple appearance of its tail. The tail was distinctly, though faintly, visible to η Herculis, and considerably curved, the curve of the concavity differing from that of the convexity. The tail, for about 5° from η Herculis, seemed divided into several parts; or rather, there were visible three dark stripes, some 5° in length, and near the centre, the middle one being most conspicuous. By looking a little to one side, I fancied that I could see five. I am describing the appearance to the naked eye. I observed the same appearances the following evening, but they were not so striking."

PERRY CITY, NEW YORK. TROWBRIDGE. (*Astron. Journal,* No. 118, p. 176.)

"I noticed, on the evening of the 9th instant, that the tail of the Comet appeared to the naked eye divided into four branches, throughout the last 10° of its extremity. I tried many means to see if it were not an optical illusion, but found it divided every time. I saw it so again on the 10th, but not so plain."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 33.)

"Die gleichmässige Färbung der Axe des Schweifes hat noch zugenommen.

"Fürs blosse Auge beträgt die Länge des Schweifes 37°; es hatte sich die gestern bemerkte Schichtung und säulenartige Structur des obern Theiles vom Schweife noch mehr ausgebildet. Die beiden hellsten Säulen hatten eine gemeinschaftliche Spitze in α Coronæ, von wo sie divergirend aufstiegen, so dass die eine durch τ Coronæ, die andere durch $\varkappa$ Coronæ ging. Dort waren sie $\frac{1}{2}° - \frac{3}{4}°$ breit. Sie hatten viel Aehnlichkeit mit Nordlichtstrahlen und verlängerten und verkürzten sich wie diese mit grosser Schnelligkeit. Später als der Comet untergegangen war, bemerkte man von diesen Strahlen Nichts; der nördliche Himmel war aber durch Nordlichtschein sehr hell."

The view of the Comet to the naked eye on October 9th is represented on Plate XVIII.; the outlines of the tail, on Plate XXVI. Section III.; the secondary tails, on Plates XVIII. and XXIV.; and the telescopic view, on Plate XL.

1858. October 10. (Plates XIX., XXIV., XXVI. Section III., and XLI.)

The 10th was the day of the nearest approach of the Comet to the earth. It appeared in its greatest expansion, but with increasing diffuseness and dimness of outline.

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

The tail showed clearly the strange alternation of dark and bright bands. They were 5° long by 20′ to 30′ broad, and diverged but little from one another, resembling the streamers which often break up the continuity of an auroral arch.

The tail was about 10° broad near Corona Borealis, reaching nearly to a line joining α Lyræ and β Ursæ Minoris. In the telescopic view, the contrast between the brightness of the two sides of the tail was far less marked than it has been.

The distance from the nucleus to a point on the line from α Lyræ to β Ursæ Minoris, towards which the tail was directed, gives nearly 64° for its extreme length, measured on the arc of a great circle. This was the greatest extent observed during the apparition of the Comet.

MÜNSTER. HEIS. (*Astron. Nachrichten,* 1169, p. 271.)

"Der Schweif hatte im Vergleich zu dem vorhergehende Tage an Länge nicht

verloren, dagegen war er breiter geworden, etwa 10° gegen das Ende hin. Die Tangentiallinie ging zwischen α und ε Serpentis."

A manuscript chart of the tail and neighboring stars has been communicated by Prof. Heis.

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, pp. 317, 318; 1174, p. 343.)

"Am folgenden Abend des 10 Octbr. zeigte sich dieselbe Erscheinung. Der Schweif war ganz wie gestern in zwei Theile getheilt; die hervortretenden Säulen an der linken Seite waren aber erheblich weiter zu verfolgen als gestern. Die oberen Partien dagegen hatten an Helligkeit abgenommen. Die Länge des Schweifes betrug noch 40°, die grösste Ausdehnung in der Breite, die am heutigen Abend ihr Maximum erreichte, war nicht geringer als 10°.

"Der Winkel, welchen die Verlängerungen der Schweifäste mit einander bildeten, war grösser als in den frühern Tagen, so dass seit Ende Septbr. eine beständige Zunahme dieses Winkels stattgefunden hat."

"Beobachtete Puncte im Schweife: —

M. B. Z.	α 1858.0	δ 1858.0	α ☄	δ ☄
Oct. 10.319	243° 56′	+24° 27′	227° 36′	+3° 32′
10.319	234 54	15 53		
10.319	240 12	+17 27"		

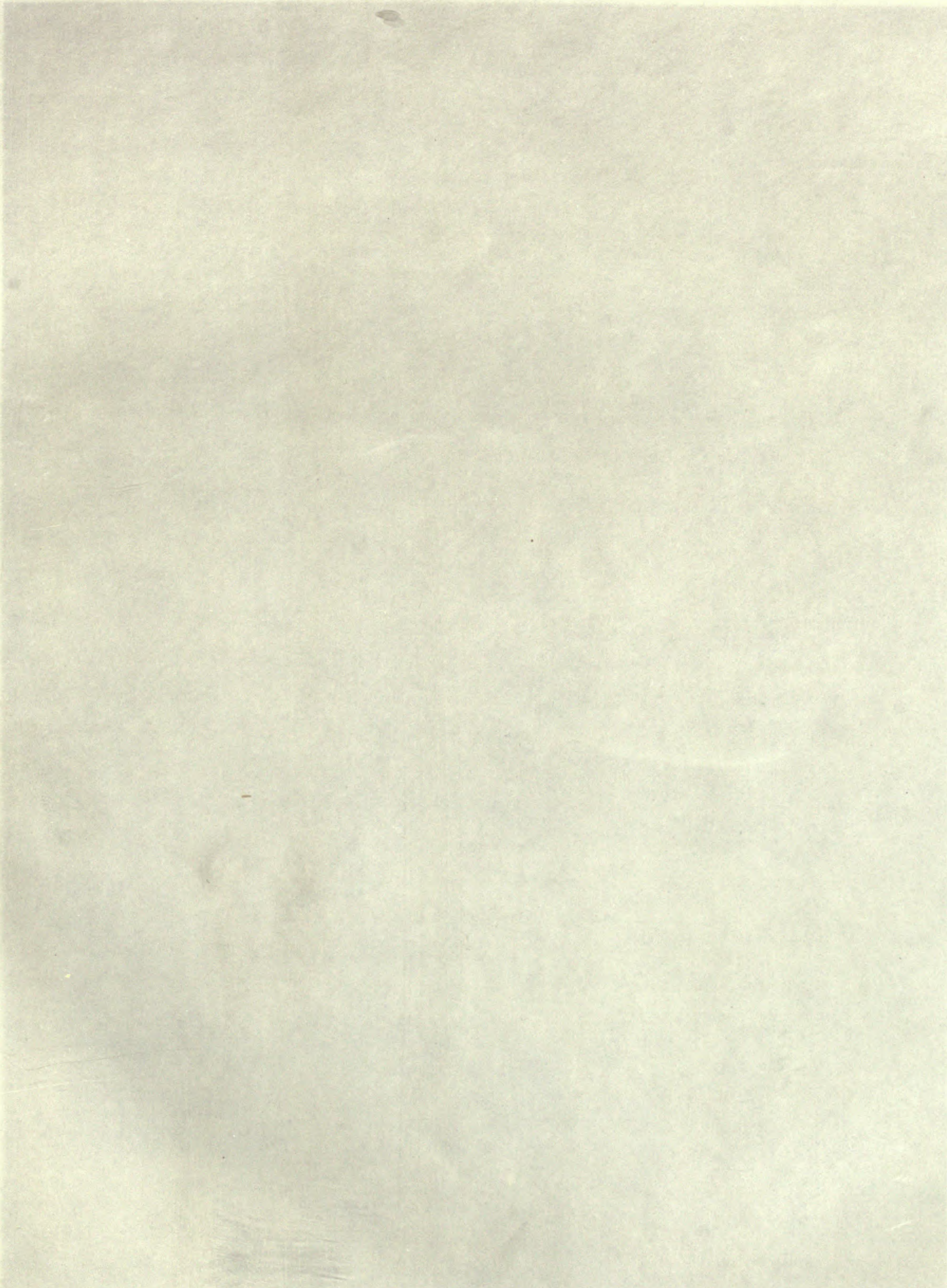
DESSAU. SCHWABE. (*Astron. Nachrichten*, 1165, p. 208.)

"Der Schweif blieb fortwährend auf der convexen Seite heller, jedoch war der Unterschied mit der concaven geringer als früher. Die schattenartige Stelle am Kern, so wie die Lichtschwäche im mittleren Theile des Schweifes, zeigten sich weniger augenfällig als früher."

ALBANY, NEW YORK. SEARLE AND TOOMER. (*Astron. Journal*, No. 119, p. 184; 127, p. 51.)

"The length of the main portion of the tail was 37°; one of the faint branches, however, extended to the length of 43°. The breadth at δ Serpentis was $4\frac{1}{2}$°, the bright portion tapering from that point to the extremity, where the breadth, including faint branches, was roughly estimated at 10°. Mr. Toomer estimated the length as 40°, and the maximum breadth as 16°. . . . . .

Wash. m. s. t.	α	δ
Oct. 10.290	229° 45′	+3° 20′
10.290	234 0	7 5
10.290	234 45	8 0
10.290	239 15	13 50
10.290	241 24	16 55
10.290	243 24	19 46
10.290	244 40	+21 38"



[illegible] dagegen war er breiter geworden, etwa 10' [illegible] Tangentiallinie ging zwischen α und ε Serpentis."

A manuscript chart of the tail [illegible] by Prof. Heis.

ALTONA. [illegible]

"Am [illegible] Der Schweif [illegible] Säulen [illegible] Die [illegible] Länge des Schweifes [illegible] am heutigen Abend ihr Maximum erreicht [illegible]

"Der Winkel, welchen [illegible] bildeten, war grösser als [illegible] beständige Zunahme dieses Winkels [illegible]

"Beobachtete [illegible]

[illegible] +8° 32'

[illegible]

"[illegible] war der [illegible]

[illegible] inches, [illegible] the [illegible] breadth, [illegible] estimated

PLATE XIX.

G.P. Bond Del.

J.W. Watts Sc.

COMET OF DONATI 1858.

OCTOBER 10TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE.

Printed by Chas. D. Andrews.

MUSSOOREE, INDIA. (Lat. +30° 17′. Long. 5^h 12^m E.) TENNANT. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 186.)

"The tail of the Comet extended to a point in the line between β Herculis and η [ε?] Coronæ; distance from β one third of distance of η [ε?]."

TRETIRE, ENG. WEBB. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 23.)

"The curvature appeared regular as far as a line joining α Coronæ and ζ Herculis, or perhaps a little farther; thence a fainter ray of considerable breadth was deflected at a large angle, perhaps 60°, as far as the stars of *Quadrans Muralis.* This portion was very feeble, but certain, and looked quite like a scattered and abandoned vapor. Another observer agreed with me in suspecting that it was less bright at its connection with the regular tail than a little farther off."

Taking the centre of the constellation *Quadrans Muralis* in AR 232°, Dec. +52°, this gives 48° for the length of the tail.

The appearance of the Comet on the 10th of October to the naked eye is represented on Plate XIX.; the outlines of the tail, on Plate XXVI. Section III.; and the secondary tail, on Plates XXIV. and XIX. The telescopic aspect is represented on Plate XLI.

1858. October 11. (Plates XX., XXIV., XXVI. Section III., and XLII.)

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"The dark stripe in the axis is scarcely discernible. Possibly this may be owing to the diffusion of light caused by haze in the sky; but I think that a change has really taken place, and that, even to the naked eye, the preceding (convex) side of the train is scarcely as bright as the other." (This remark probably applies only to the part near the nucleus.)

CAMBRIDGE, ENG. CHALLIS. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 19.)

"Greater angular separation of the streams of the tail; the hood not so definitely bounded, the central brightness rounder, probably owing to the state of the atmosphere, the comet being low.

"A sketch exhibited a determination of the hood towards the left side, but the two streams of the tail of equal intensity. To the naked eye the tail was much spread out laterally, especially at the extreme part, and the nucleus was less bright. The length of the tail was judged, by reference to stars, to be 30°."

MARKREE. COOPER. (*Obs. of Donati's Comet* 1858, *Markree*, p. 13.)

"The tail seems a little more bent near the head than heretofore. Mr. Cooper remarks that the brighter portion still comes to a point a little above the middle on the east side."

LIVERPOOL. HARTNUP. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 56.)

"Distance from centre of nucleus to front of coma . . . . = 4′ 19″

"Diameter of coma at right angles to tail, measured through centre of nucleus . . . . = 10′ 39″."

MÜNSTER. HEIS. (*Astron. Nachrichten*, 1169, p. 271.)

"Bei nebeliger Luft konnte der Schweif nur 29° weit verfolgt werden."

A manuscript chart of the tail and of neighboring stars has also been communicated.

VIENNA. HORNSTEIN. (*Annalen der Wiener Sternwarte*, F. III., IX. p. 181.)

"Am 11 October ging der Ostrand des Schweifes bei ε Serpentis vorbei, und reichte weit über s * Herculis hinaus, während der Westrand λ und γ Serpentis und ν Herculis berührte.

"Von diesem Tage an nahm die Länge des Schweifes nicht mehr zu, aber die Breite vergrösserte sich noch erheblich."

VIENNA. SCHMIDT. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge . . = 60° (sehr klar).
Grösste Breite des Schweifes . . . . = 18°.0." †

OXFORD. SLATTER. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 25.)

"The tail had become gradually more and more curved."

TRETIRE, ENG. WEBB. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 24.)

"The tail has lost all the deflected prolongation, and extends in a simple curve a little above ζ Herculis, perhaps to ν, its concave part is much scattered, and it has probably a breadth of 8° or 10°."

The appearance of the Comet to the naked eye on October 11th is represented on Plate XX.; the outlines of the tail, on Plate XXVI. Section III., and Plate XXIV. The telescopic view is represented on Plate XLII.

1858. October 12. (Plates XXI., XXIV., XXVI. Section III., and Fig. 6.)

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"Cleared suddenly after the head of the comet had set. The tail was nearly vertical, reaching to within 12° of α Lyræ. The bright and dark bands are not so evident as they have been, but there is one prominent streak rising higher than the rest. The light of the train is evidently waning."

* s Herculis being a star of only the 6th magnitude, and in the neighborhood of several much brighter stars, is not likely to have been taken for a point of reference; it is probable that this is an error, — perhaps a misprint for ζ Herculis. There is an error also in the star designated as ν Herculis.

† This was the maximum observed breadth of the tail.

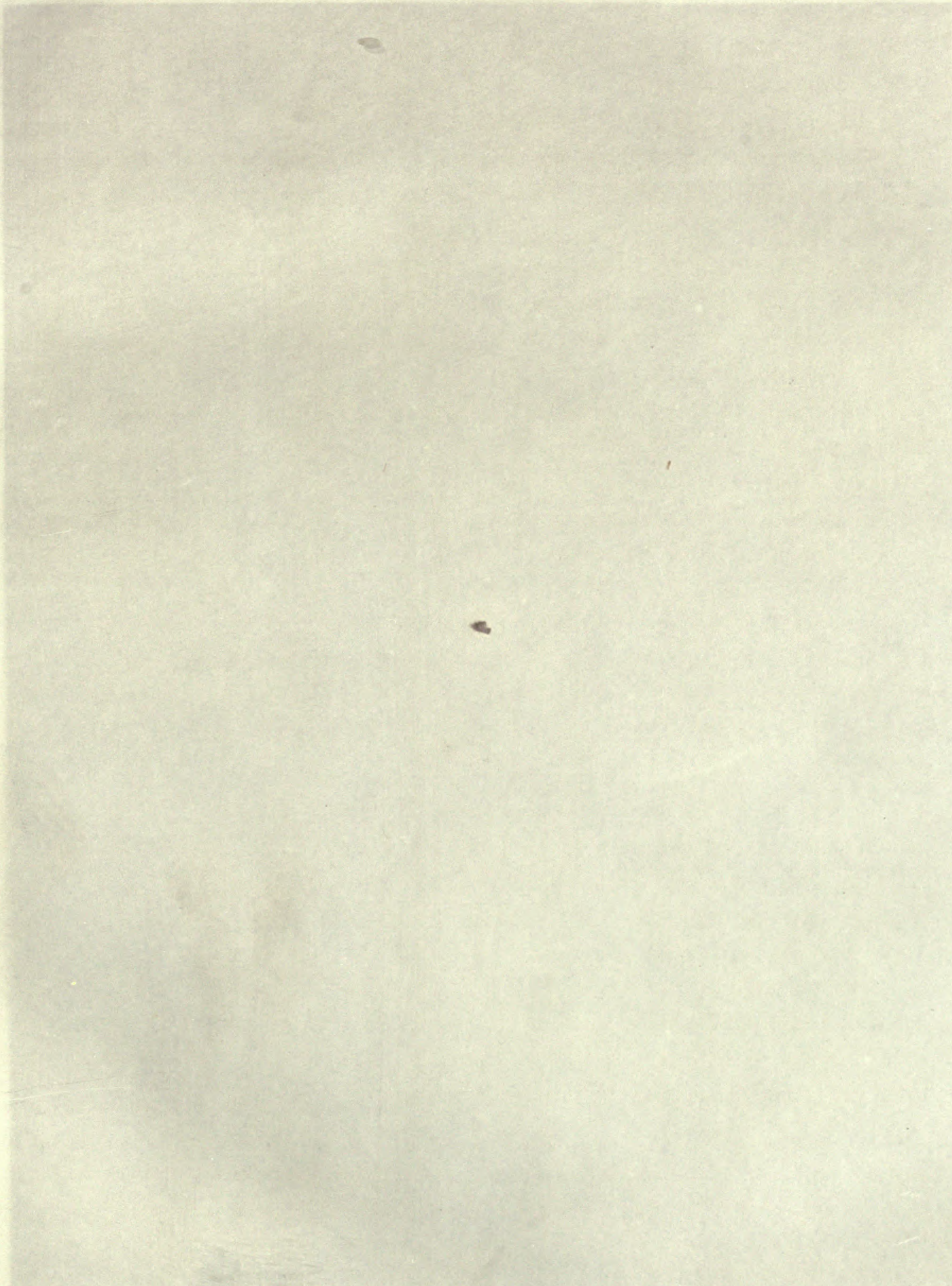


PLATE XX

G.P. Bond Del.

J.W. Watts Sc.

COMET OF DONATI 1858.

OCTOBER 11TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE

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Ship "Charles." (Lat. S. 35° 50′. Long. 21° 8′ W.) Callow. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 49.)

"Two stars, one of which belonged to the bow of Sagittarius [Serpens?], were visible through the luminous vapor of the tail; one of these stars [μ Serpentis?] was 2° 0′ distant from the nucleus, as near as could be observed with the aid of a sextant. The nucleus was very bright, and visible after sunset before any stars in the same region of the heavens; being also seen through cumulus and cumulo-stratus clouds."

Melbourne, Australia. Ellery. (*Photographic Copy and Lithograph.*)

Sketch of the Comet.

Oporto, Portugal. Baron de Forrester. (*Mss. Copy communicated.*)

Sketch of the Comet and stars near it.

Münster. Heis. (*Astron. Nachrichten*, 1169, p. 271.)

"Die Luft war ausgezeichnet hell. Sowohl der Kopf als der Schweif des Cometen hatten im Vergleich zu den vorhergehenden Tagen ungemein an Helligkeit verloren. Die Breite des Schweifes, dessen Licht sehr diffus war, betrug zwischen α und β Herculis 13°. Auffallend war es mir dass der Schweif im Vergleich zu den vorhergehenden Tagen, wieder an Länge gewonnen hatte. Ich konnte ihn deutlich bis δ Herculis, 35 Grad weit verfolgen."

A manuscript chart of the Comet and of stars in its neighborhood has also been communicated.

Dorpat. Lais. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. p. 59.)

"Die scheinbare Grösse des Schweifes hat bedeutend abgenommen, sein Ende reicht bis δ Herculis."

Altona. Pape. (*Astron. Nachrichten*, 1172, p. 318; 1174, pp. 342, 343.)

"Die Erscheinung des Schweifes war von den frühern gänzlich verschieden. . . . . . Die ganze linke Seite der Coma und des dem Kern zunächst gelegenen Schweifes war weit heller, als die rechte. Die Ausdehnung des Nebels auf der Sonnenseite mochte etwa 2 – 3′ betragen. . . . . . Die Begrenzung der vorangehenden Seite hatte in etwa 6° Abstand vom Kern eine starke Krümmung nach rechts, bildete dann fast 20° weit eine wenig convexe Krümmung und bog sich am oberen Ende, wo der Schweif in eine Spitze unter δ Herculis verlief, noch etwas weiter nach rechts hinüber. Die rechte Seite war durch eine doppelt gekrümmte Curve begrenzt, die aber offenbar noch von einer sehr schwachen Dunstmasse umgeben war, deren Grenzen ins Unbestimmte verliefen. Die Mattigkeit des Schweiflichts, verglichen mit dem hellen Glanze in den Tagen vom 4ten zum 9ten October, war auffallend."

"Am 12ten war der vorangehende Rand weniger zurückgebogen, der nachfolgende Rand gewissermassen doppelt, wie die für diesen Tag gegebene Zeichnung es deutlicher als eine Beschreibung zeigt. Hiernach schien es, als ob seit dem 9ten October sich ein zweiter Schweif aus dem Hauptschweife herausgedrängt habe, dessen Theilchen eine weniger gekrümmte Curve verfolgten, als die des Hauptschweifes. Letzteren konnte man am 9ten und 10ten sehr deutlich in grösser Ausdehnung, aber verwaschen und von Tag zu Tag verkürzt, wahrnehmen. . . . . .

"Beobachtete Puncte im Schweif:—

M. B. Z.	α 1858.0	δ 1858.0	α ☄	δ ☄
Oct. 12.308	250° 45′	+13° 30′	233° 26′	—3° 30′
	245 58	5 47		
	243 3	+10 0"		

A lithograph accompanies the above.

MADRAS. POWELL. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 65.)

"The tail much longer, but fainter; the axial darkness down the envelope not visible."

The appearance of the Comet to the naked eye on October 12th is represented on Plate XXI.; and the outlines of the tail, on Plates XXIV. and XXVI. Section III.

1858. October 13. (Plates XXIII., XXIV., and XXVI. Section III.)

MELBOURNE, AUSTRALIA. ELLERY. (*Photographic Copy and Lithograph.*)

Sketch of the Comet.

OPORTO, PORTUGAL. BARON DE FORRESTER. (*Mss. Copy communicated.*)

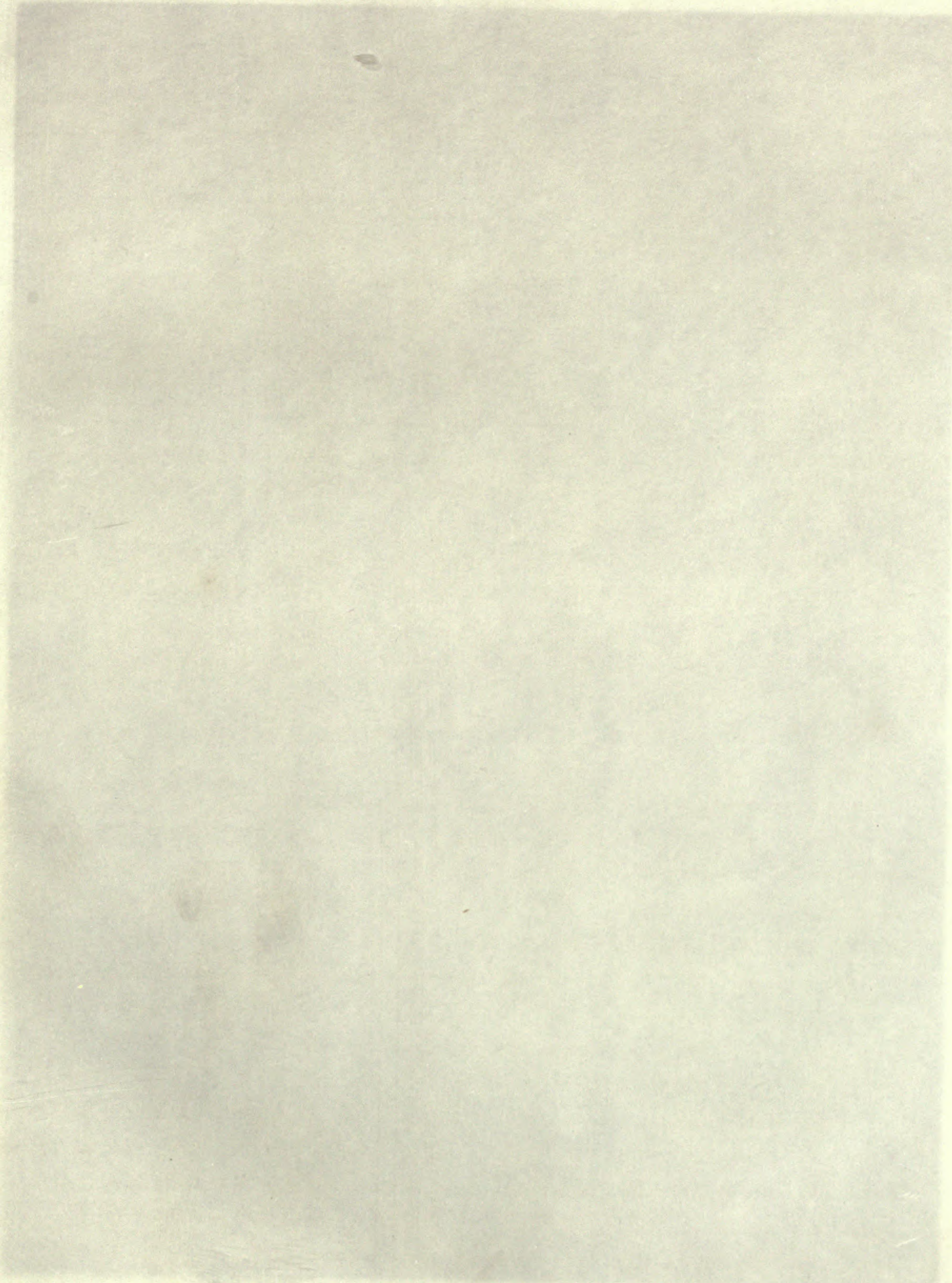
Sketch of the Comet and stars near it.

GENEVA. PLANTAMOUR. (*Note sur la Comète de Donati*, p. 12.)

"Malgré l'éclat de la lune, qui était presque dans son premier quartier et assez voisine de la comète, j'ai estimé la longueur de la queue à plus de 32°; la comète se trouvait alors à 236° 15′ ascension droite et —6° 57′ déclinaison, et la queue passait près des étoiles suivantes:—

	Ascension droite.	Déclinaison.
Un peu à l'ouest de ε Ophiuchus	242°	— 4°
Près de κ Ophiuchus	252	+10
Près de κ Hercule	256	+14.5

"Jusqu'à α Hercule, sur une longueur de 29°, la queue était parfaitement distincte et bien terminée; au delà de cette étoile, je pouvais encore la distinguer, mais faiblement, sur une longueur de quelques degrés, dans la direction de 262° ascension droite et +20° déclinaison. Si on calcule la position de points situés sur le prolongement du rayon vecteur, on trouve:—



"[illegible] war der [illegible] Rand weniger zurückgebogen, der [illegible] [illegible] gewissermassen doppelt, wie die für diesen Tag gegebene [illegible] es [illegible] als eine Beschreibung zeigt. Hiernach schien es, [illegible] habe, [illegible] sich ein zweiter Schweif aus dem Hauptschweife [illegible] habe, [illegible] eine weniger gekrümmte Curve verfolgten, als die des Haupt-schweifs. [illegible] konnte man am 9^{ten} und 10^{ten} sehr [illegible] in grosser Aus-dehnung [illegible] und von Tag zu Tag verkürzt, [illegible]. . . . .

"[illegible] Punkte im Schweif: —

[illegible]	α 1858.0	δ 1858.0	[illegible]	[illegible]
[illegible]	250° 45′	+13° 30′	[illegible]	—3° 30′
	245 58	[illegible] 5 47		
	243 3	[illegible] 10 [illegible]		

A lithograph accompanies the above [illegible]

[illegible] POWELL. (*Monthly Notices Royal Ast. Soc.* [illegible])

"The tail much longer, but fainter, the [illegible] the envelope not [illegible]."

The appearance of the Comet to the [illegible] is represented on Plate XXI.; and the outlines of the [illegible] XXVI. Section III.

1858. October 13. (Plate [illegible])

MELBOURNE, AUSTRALIA. [illegible]

Sketch of the Comet.

OPORTO, PORTUGAL. BARON DE [illegible]

Sketch of the Comet and stars [illegible]

GENEVA. PLANTAMOUR. (*Note sur la Comète* [illegible])

"Malgré l'éclat de la lune, qui était [illegible] et assez voisine de la comète, j'ai estimé la [illegible] de 22°; la comète se trouvait alors à 250° [illegible] déclinaison, et la queue passait près des étoiles [illegible]

[illegible]

Un peu [illegible] [illegible] 8

[illegible] [illegible] 10

[illegible] [illegible] 14.5

"Jusqu'à [illegible] parfaitement dis-tinctes et bien [illegible] le distinguer, mais faiblement, [illegible] de 262° ascension droite et [illegible] situés sur le prolongement du rayon vecteur, [illegible]

PLATE XXIII

G.P. Bond Del.

J. W. Watts Sc.

COMET OF DONATI 1858.

OCTOBER 13TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE.

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		Ascension droite.	Déclinaison.
Comète, rayon vecteur	0.65	236° 15′	—6° 57′
1^er^ point sur le prolongement	0.75	246 26	6 10
2^me^ idem	0.85	257 25	5 5
3^me^ idem	0.95	268 25	—3 49

"Le prolongement du rayon vecteur se projette sur la sphère céleste suivant un arc, qui fait un angle de 27° avec la partie de la queue comprise entre la comète et ε Ophiuchus, et un angle de 43° avec un arc qui passerait par la comète et κ Hercule. L'arc sur la sphère céleste correspondant à un prolongement du rayon vecteur égal à 0.3 est de 32° 10′, on peut ainsi admettre que ce jour-là la longueur linéaire de la queue était égale à 0.3, soit 10.5 millions de lieues."

Poulkova. O. Struve. (*Pulk. Beob. des Grossen Cometen* 1858, p. 14.)

"Ausdehnung des Cometen:

Auf der vorangehenden Seite zu . . . 80″

" nachfolgenden " . . 120″

"In dem Abstande von 3′ wurde die Breite des Cometen auf 6′ – 7′ geschätzt. Von diesen kommen beiläufig 1′ auf die dem Schweife vorangehende schwache Nebelmasse, 1′.5 auf den hellsten Theil der vorangehenden Schweifhälfte, 2′ auf den dunklen Zwischenraum, und 2′.5 auf die nachfolgende Schweifhälfte. . . . . . Lieutenant Smysloff verzeichnete aber noch mit blossem Auge den Lauf des Schweifs zwischen den Sternen. Die letzten Spuren desselben glaubte ich auf halbem Wege zwischen α Herculis und α Lyræ zu erkennen. Die Breite des Schweifs hatte seit dem 9 October noch merklich zugenommen; von dunklen Streifen in denselben war heute nichts zu erkennen."

A lithograph accompanies the above.

Poulkova. Winnecke. (*Pulk. Beob. des Grossen Cometen* 1858, p. 33.)

"Der Schweif ist entschieden schwächer geworden, jedoch konnte man noch Spuren davon jenseit α Herculis wahrnehmen, woraus eine Länge von 30° folgt."

The appearance of the Comet to the naked eye on October 13th is represented on Plate XXIII.; and the outlines of the tail, on Plates XXIV. and XXVI. Section III.

1858. October 14. (Plate XXIV. and Fig. 7.)

Melbourne, Australia. Ellery. (*Photograph Copy and Lithograph.*)

Sketch of the Comet.

Oporto, Portugal. Baron de Forrester. (*Mss. Copy communicated.*)

Sketch of the Comet and stars near it.

VIENNA. HORNSTEIN. (*Annalen der Wiener Sternwarte*, F. III., IX. pp. 181, 182.)

"Am 14 und 15 October . . . . . der dunkle Theil des Schweifes zwischen den Aesten war sehr unbestimmt begrenzt. Dieser letztere Raum schien sich von Tag zu Tag mehr mit Lichtmaterie zu füllen."

CAPE OF GOOD HOPE. MACLEAR. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 77.)

"Length of tail 14°."

DORPAT. MÄDLER. (*Beob. Kaiserl. Sternw. Dorpat*, Vol. XV. p. 50.)

"Das Ende des Schweifes war gegen α Ophiuchi gerichtet, doch konnte nicht entschieden werden ob er diesen Stern erreichte."

VIENNA. SCHMIDT. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge . . 34°.0
Grösste Breite des Schweifes . . . . 14°.0"

FRIGATE "NOVARRA." (Lat. S. 8° 36′. Long. 161° 43′ W.) WÜLLERSTORF. (*Astron. Nachrichten*, 1190, p. 217.)

"Länge des Lichtschweifes: 33° 20′; ziemlich reine Luft."

The outlines of the tail on October 14th are represented on Plate XXIV.

1858. October 15. (Plates XXII., XXIV., and XLIII.)

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"Tail 15° long; may be as bright to the naked eye as a star of the 3d magnitude."

OPORTO, PORTUGAL. BARON DE FORRESTER. (*Mss. Copy communicated.*)

Sketch of Comet and stars near it.

BRESLAU. GALLE. (*Astron. Nachrichten*, 1179, p. 41.)

"Der Comet zeigte im Ganzen noch dasselbe Ansehen wie in der vorigen Woche, indess war die Luft in der Nähe des Horizontes zu dunstig, um über die allmäligen Abstufungen der Helligkeit und deren Grenzen Genaueres bemerken zu können. Der vom Kern ausgehende Fächer oder Büschel schien mit seiner Centrallinie nicht genau das Schweif-Conoid zu halbiren, sondern näher der Richtung des breiteren Zweiges (rechts im F.) sich auszuschliessen. — Der Schweif ging zwischen ζ und η Ophiuchi hindurch, um $\frac{1}{6}$ ζ η näher an ζ."

CLINTON, N. Y. OBSERVATORY OF HAMILTON COLLEGE. PETERS. (*Communicated in Mss.*)

"The dark stripe in the axis very distinct, and was traced for more than half a degree. — Its deviation to the right of the axis of the tail was striking."

VIENNA. SCHMIDT. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge . . 20°.0
Grösste Breite des Schweifes . . . . 5°.0"

[illegible] (Annalen der Wiener Sternwarte, F. III. IX., p. 134, 1859.)

"[illegible] und 15 October . . . . der dunkle Theil des Schweifes [illegible] den [illegible] sehr [illegible] Dieser letztere Raum schien sich von Tag zu Tag [illegible] zu füllen."

[illegible] (Memoirs Royal Astr. Soc., Vol. XXIX. p. [illegible])

"[illegible]"

[illegible] (Beob. Kaiserl. Sternw. Dorpat, Vol. XV. p. [illegible])

"[illegible] des Schweifes war gegen α Ophiuchi gerichtet, doch konnte nicht [illegible] werden ob er diesen Stern erreichte."

[illegible] (Communicated in Mss.)

"Länge des Schweifes für das blosse Auge	34°.0
Grösste Breite des Schweifes	14°.0"

Fregatte "Novarra." (Lat. S. 8° 30', Long. [illegible]) Wüllerstorf. (Astron. Nachrichten, 1189, p. 217.)

"Länge des Lichtschweifes: 35° 20' [illegible]."

The outlines of the tail on October [illegible] are represented on Plate XXIV.

1858. October 15. (Plates XXII. XXIV. [illegible])

Observatory of Harvard College. [illegible]

"Tail 15° long; may be as bright [illegible] a star of the 3d magnitude."

Oporto, Portugal. Baron [illegible] (Mss. Copy [illegible])

Sketch of Comet and stars [illegible]

Breslau. Galle. (Astron. Nachrichten, 1173, p. 41.)

"Der Comet zeigte im Ganzen noch dasselbe [illegible] in der vorigen Woche, indess war die Luft in der Nähe des [illegible] über die allmäligen Abstufungen der Helligkeit und [illegible] zu können. Der vom Kern ausgehende [illegible] Centrallinie nicht genau das Schweif-[illegible] Richtung des breiteren Zweiges [illegible] ging zwischen ζ und η Ophiuchi hindurch, [illegible]"

Clinton, N. Y. Observatory of Hamilton College. [illegible] (Communicated in Mss.)

"The dark stripe in the axis very distinct, and was traced for more than half a degree. — Its deviation to the right of the axis of the tail was striking."

Vienna. Schmidt. (Communicated in Mss.)

"Länge des Schweifes für das blosse Auge	20°.0
Grösste Breite des Schweifes	5°.0"

COMET OF DONATI 1858.

OCTOBER 12TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE PLATE XXI

G P Bond Del.

J W Watts Sc.

COMET OF DONATI 1858.

OCTOBER 15TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE PLATE XXII

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ALBANY, NEW YORK. SEARLE AND TOOMER. (*Astron. Journal*, No. 127, p. 51.)

Wash. m. s. t.	α	δ
"Oct. 15.290	245° 25′	—13° 50′
15.290	259 42	— 6 5"

KINGSTON, CANADA WEST. WILLIAMSON. (*Canadian Journal*, Vol. III. p. 487.)

"On the 15th, the tail, though much fainter and diminished in magnitude, appeared broader and of a more hyperbolic form than before."

The appearance of the Comet to the naked eye on October 15th is represented on Plate XXII.; the outlines of the tail, on Plate XXIV.; and the telescopic view, on Plate XLIII.

After the middle of October the Comet was best seen from the southern hemisphere, but the more distant parts of the tail had become too faint to attract notice.

1858. October 16. (Plate XXIV.)

MARKREE. COOPER. (*Obs. of Donati's Comet* 1858, *Markree*, p. 13.)

"Mr. Cooper also observed that the tail seemed to diverge at a greater angle than on former nights; this he noticed first with an opera-glass, and found that the telescope confirmed his impression. He could trace the tail with the opera-glass about 3°. He fancied that it was considerably bent near the head."

BRESLAU. GALLE. (*Astron. Nachrichten*, 1179, p. 42.)

"Das Ansehen des Cometen wie gestern. Der Kern sehr hell vor dem übrigen Nebel hervortretend. Der Schweif, noch immer gekrümmt, trifft die Linie ζ η Ophiuchi näher an η, so dass diese Linie in dem Verhältniss 2 : 3 getheilt wird."

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, p. 319.)

"Der letzte Abend, an welchem ich den Cometen sah, war der des 16ten Octbr. . . . . . Ich glaubte nur noch wahrzunehmen, dass die dunkle Zone zwischen den Schweifästen beinahe verschwunden war."

VIENNA. SCHMIDT. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge . . 8°.0
Grösste Breite des Schweifes . . . . 2°.0"

VIENNA. WEISS. (*Annalen der Wiener Sternwarte*, F. III., IX. p. 182.)

"Er [referring to the dark opening between the branches of the tail] am 16 October selbst in der Nähe des Kernes von den helleren Schweifpartien nur wenig mehr unterschieden war."

The outlines of the tail on October 16th are given on Plate XXIV.

1858. October 17. (Plate XXIV.)

Melbourne, Australia. Ellery.

Photographic copies of drawings and lithographs representing the appearance of the tail among the stars.

Neuchatel. Jeanjaquet. (*Souvenirs de la Comète de* 1858, p. 19.)

"Les bords, vu l'obscurité médiane, sont toujours la partie la plus éclairée de l'appendice."

Clinton, N. Y. Observatory of Hamilton College. Peters. (*Communicated in Mss.*)

"The tail appeared pretty bright at the edges, and its breadth, at 15′ from the nucleus, was estimated to be 10′ between the outside limits of the bright light. The estimate was carefully made."

Vienna. Schmidt. (*Communicated in Mss.*)

"Länge des Schweifes für das blosse Auge . . 4°
Grösste Breite des Schweifes . . . . 1°"

The outlines of the tail on October 17th are represented on Plate XXIV.

1858. October 18. (Plate XLIV.)

Observatory of Harvard College. G. P. Bond.

"Comet greatly diminished in brightness; near the nucleus the north branch of the tail brightest."

The telescopic appearance of the Comet at this date is represented on Plate XLIV.

1858. October 19. (Plate XLV.)

Observatory of Harvard College. G. P. Bond.

"The tail is still curved as usual, but an arc of only 5° or 6° is plainly seen. No difference in the brightness of the two sides is noticeable. In the finder it looks much more compressed towards the axis than usual, being only 6′ wide at 50′ from the nucleus, the outlines being nearly parallel at 15′. In the great refractor, its breadth at 12′ from the nucleus is 5′."

The above measurements of the width of the tail show a great change from its previous aspect. It should not, however, be overlooked, that, at the low altitude of the Comet, the extinction by the atmosphere must have obliterated any faint nebulosity which may have existed outside of the above limits. The numbers given are confirmed by Maclear's measurements on the 23d and 30th, at the Cape of Good Hope.*

* In the great Comet II. of 1861, a similar change occurred. On the 3d of August the tail, viewed with the great refractor at the Observatory of Harvard College, had apparently collapsed, within a distance of half a degree from the nucleus, to scarcely one eighth of its previous width; but a comparison of its aspect in different telescopes showed that the former outlines still remained, although easily overlooked, under an unfavorable atmosphere like that through which the Comet was seen in the present instance.

The appearance of the Comet in the telescope on October 19th and 20th is represented on Plates XLV. and XLVI.

1858. October 20. (Plate XLVI.)

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

The telescopic aspect of the Comet is represented on Plate XLVI.

1858. October 21.

RIO JANEIRO. LIAIS. (*Comptes Rendus*, XLVIII. p. 625.)

"Longueur de la queue, qui était de 12 degrés au moins le 21 Octobre."

1858. October 22.

CAPE OF GOOD HOPE. MACLEAR. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 77.)

"Moonlight and the glare of *Venus* prevent a correct estimate of the length of the tail; it appears to be about 4°. The head is still bright."

1858. October 23.

CAPE OF GOOD HOPE. MACLEAR. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 77.)

"Diameter of the tail half-way down $= 8' \ 24''$."

1858. October 24. (Figs. 8_a and 8_b.)

MELBOURNE, AUSTRALIA. ELLERY.

Lithograph representing the appearance of tail with the telescope and among the stars, from which Figs 8_a and 8_b have been taken.

Fig. 8a.

Fig. 8b.

The curve of the tail tends slightly in a direction opposed to that which had hitherto distinguished it. The northern edge, near the nucleus, is also brighter than the southern. It deserves attention, that the drawing on November 7th, Fig. 9, indicates the same peculiarity, but more strongly marked, the northern side being prolonged considerably beyond the other, and brought nearly to a point at its extremity. The bending of this side towards the south is quite decided, indicating,

if the figure may be relied on, an anomaly resembling that noticed about the 1st of September.*

A series of views communicated by the kindness of R. L. J. Ellery, Esq., Director of the Observatory of Williamstown, Victoria, shows the bifurcation of the tail on the 12th of October, and on the 13th and 17th, though less strongly; the southern branch being, according to Mr. Ellery's description, the brightest; † the two diverging at an angle of from four to seven or eight degrees; but on November 12th there is no indication of division into two branches.

The nebulous patch towards which the tail tends in Fig. 8_b is in AR. 265° 50′, Dec. —34° 42′, which may be taken as its terminal point at this date. This is the last observation by the naked eye sufficiently precise to fix the position of the tail.

Brelum. (Lat. +11° 55′. Long. E. 104° 50′.) Arnoux. (*Comptes Rendus*, XLVIII. p. 852.)

"Queue, qui soustendait un arc de la voûte céleste d'environ 10 degrés."

The Comet was seen for the last time at the Observatory of Harvard College on October 25th, at an altitude of 3°, the sky being very clear. The nucleus was still bright, but the tail was only 1° long.

1858. October 27.

Madras. Powell. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 65.)

"Tail 4° to 5°."

1858. October 30.

Cape of Good Hope. Maclear. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 77.)

"The Comet's tail is inclined northwards of the parallel 7°. The interval between the transit of the head and end of the tail = 7^m 45^s. Breadth of head = 4′ 5″. Breadth of tail half-way down = 7′ 12″."

1858. October 31.

Cape of Good Hope. Maclear. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 77.)

"Interval between the transit of head and end of tail = 7^m 20^s. Tail inclined northward of the parallel 6′ 35″ [6° 35′ ?]. The end of the tail on the north side appears like a feather-edge torn off."

1858. November 4.

Ship "Charles." Callow. (*Monthly Notices Royal Astr. Soc.*, Vol. XX. p. 50.)

"Comet visible for a short time this evening; it is now in the constellation

* Compare the remarks on this subject under that date.

† Compare, however, the observations on October 24 and November 7.

Corona Australis; its shape is somewhat altered, the head being more pointed and the tail like a double bow." Perhaps referring to the bifurcation of the tail.

1858. November 7. (Fig. 9.)

MELBOURNE, AUSTRALIA. ELLERY.

Lithograph of Comet.

The figure on November 7, as well as that on October 24, is remarkable for an indicated change in the direction of the curvature of the tail. The right-hand branch has also become longer than the other.

Fig. 9.

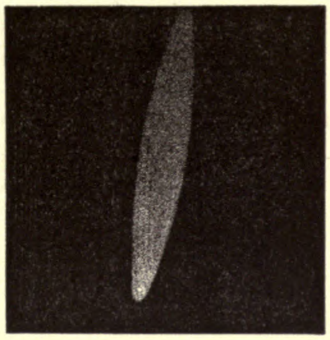


Fig. 10.

1858. November 10.

FRIGATE "NOVARRA." WÜLLERSTORF. (*Astron. Nachrichten*, 1190, p. 218.)

"Bei völlig klarem Wetter mit freiem Auge keine Spur vom Cometen zu sehen."

1858. November 12. (Fig. 10.)

MELBOURNE, AUSTRALIA. ELLERY.

Lithograph of Comet, from which Fig. 10 has been copied.

1858. December 3.

RIO JANEIRO. LIAIS. (*Comptes Rendus*, XLVIII. p. 625.)

"La longueur de la queue . . . . . s'est réduite graduellement jusqu'à 0° 55′ environ le 3 décembre. Cette queue a disparu du 3 au 6 de ce dernier mois, la comète ayant pris une forme sphérique avec le noyau un peu excentrique et placé du côté du soleil."

1858. December 8.

RIO JANEIRO. LIAIS. (*Comptes Rendus*, XLVIII. p. 625.)

"Une petite queue conique parut vouloir se reformer le 8 décembre et avait disparu le 10."

1858. December 23.

CAPE OF GOOD HOPE. MACLEAR. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 73.)

"The Comet is now merely a faint, nebulous body, about 90″ in diameter, with a slight central condensation of light. No trace of a tail."

The last allusion to the tail is on the following date, one hundred and seventy-seven days after its first appearance, and two hundred and fifty from the discovery of the Comet.

1859. February 7.

SANTIAGO, CHILI. MOESTA. (*Astron. Nachrichten*, 1257, p. 132.)

"Am 7ten Febr. machte das Mondlicht die Beobachtung sehr schwierig, doch bisher war noch eine Andeutung von Schweif vorhanden, die nun gänzlich verschwand."

II. OBSERVATIONS UPON THE SECONDARY TAILS.

IN the subjoined extracts are included notices of all appendages to the principal tail, which can be distinguished from the so-called "Columnar Structure," and from the faint "Umhüllung" described by Winnecke and others, which will be considered separately. The appearance of the principal secondary tails to the naked eye, between September 27th and October 10th is represented on Plates V. to XIX. inclusive. The outlines will also be found on the Chart, Plate XXIV.

1858. September 11.

DESSAU. SCHWABE. (*Astron. Nachrichten*, 1165, p. 206.)

"Von der linken Seite des Kopfes im astr. F. ging ein äusserst matter, kurzer Nebenschweif aus, der mit der Axe des Hauptschweifes einen Winkel von 45 bis 50 Grad machte, aber schon am andern Tage verschwunden war, und nicht wieder sichtbar wurde."

1858. September 12.

REGENT'S PARK, LONDON. HIND. (*London Times*, Sept. 13.)

"A very faint ray of light emanated from the nucleus towards the sun, as previously remarked in several of these objects, and I thought at moments that a short 'horn' or 'sector' issued therefrom at right angles to the axis of the tail."

1858. September 17. (Plate XXIV.)

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 29.)

"2^h 15^m Sternz. . . . . . Ich bemerke aber noch einen sehr schwachen Ausläufer, der vier Grad weiter geht und in der Richtung des hellern Theils des Schweifes liegt, von ihm aber durch einen dunklen Raum von 20′ Länge getrennt. Dieser neue schwache Schweif endigt einen Grad links (im Fernrohre) von 59 Ursæ Maj. Etwa ebensoweit lassen sich auch die äussersten Schweifspuren mit blossem Auge verfolgen. Positionswinkel des Nebenschweifes hiernach 350° ±, Länge 8°."

1858. September 18. (Plate XXIV).

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 29.)

"Endpunkt der Mitte des schwachen Schweifes $\alpha = 172° 47'$, $\delta = +44° 24'$ (Æq. 1800, wie bei allen derartigen Angaben im Folgenden). Breite am Ende 18′. Verlängert man die Richtung dieses Schweifes bis an die nachfolgende Seite des Hauptschweifes, so erhält man für den Absprossungspunkt $\alpha = 173° 13'$, $\delta = +40° 36'$."

The Chart accompanying the above shows the position and appearance of the secondary tail.

1858. September 19. (Plate XXIV.)

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 29.)

"14^h 8^m Mittl. Zeit. Endpunkt der Mitte des schwachen Schweifes $\alpha = 174° 20'$, $\delta = +44° 3'$."

Two Charts accompany the above. An important correction is noticed on page 69 of the memoir cited.

The secondary seems to have been lost sight of until the 27th. Probably its faint light was overpowered by the increasing brightness of the moon. At this date it first became visible to the naked eye.

1858. September 27. (Plates V. and XXIV.)

OBSERVATORY OF HARVARD COLLEGE. R. F. BOND.

Sketch of the Comet as seen with the naked eye, showing the secondary tail at 7^h 45^m m. s. t.

The following observation may be compared with the remarks upon the ray seen by D'Arrest on the 29th, and on the 11th and 12th by Schwabe and Hind.

COLLEGIO ROMANO. SECCHI. (*Mem. dell' Osserv. del Collegio Romano,* 1859, pp. 13, 15.)

"Nella sera del 27 notai che dalla testa della Cometa partiva come un raggio leggiero e sfumatissimo lungo circa mezzo grado, e quasi diametralmente opposto alla coda. Sono sicuro che ciò non era illusione dello strumento col quale l'avea

già guardata altre volte, ma sempre senza quest' appendice. Esso svanì la sera appresso e non sò ancora se altri abbia fatto la stessa osservazione, ma non sarei sorpreso, che questa particolarità fosse sfuggita, essendo tal raggio debole più che la luce della metà inferiore della coda, a quindi molto difficile ad essere riconosciuto nei cannocchiali: nè lo vidi io solo ma anche altri che eran meco."

(Note to p. 15.)

"Quel raggio retto e sottile che trovasi indicato da Bond ed altri non fu veduto da noi."

1858. September 28. (Plates VI. and XXIV.)

Dover, N. H. Tuttle.

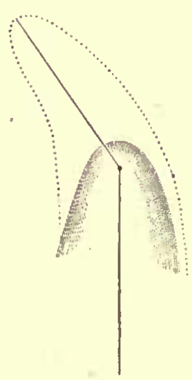
Sketch of the Comet as seen by the naked eye, showing the secondary ray.

The following account describes a phenomenon probably identical with that seen by Secchi on the 27th, and perhaps analogous to those noticed on the 11th and 12th of September by Schwabe and Hind, though apparently distinct from the distant, misty envelope (*Umhüllung*) observed at Poulkova and elsewhere. The direction of the axis is quite different, and its extent much greater; thus, Winnecke's measurements on the 30th show a difference of 147°.6 between the angles of position of the distant envelope and that of the axis of the tail, while D'Arrest gives for the difference of the axes of the two tails, reckoned in the same direction, 220°. It extended 8′ or 10′ from the nucleus, to judge by the sketch from which Fig. 5 has been taken.

1858. September 29. (Plates VII. and XXIV., and Fig. 5.)

Copenhagen. D'Arrest. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 215.)

Fig. 5.



"Den 29 Septbr. var Luften om Aftenen meget disig, men man saae alligevel nok for at forvisse sig om, at det forhen omtalte nye Hylster af 28 Septbr. nu havde udviklet sig saaledes, at det var bleven til en *anden Hale.* Halernes Axer dannede med hinanden, efter mit og Hr. Thiele's uafhængige Skjøn, en Vinkel paa omtrent 140 Grader. Dette uventede og, saavidt mig vitterligt, sjeldne Syn minder stærkt om en Tegning af den Halleyske Komet ved Sir John Herschel i Capreisen.* — Den her omtalte og paa mine Tegninger (Fig. 7) anskueliggjorte Forlængelse af det taageagtige Hylster er, mærkelig nok, *slet ikke identisk* med en anden, netop paa den Tid af andre Iagttagere observerede Sidehale. Denne sidste dannede nemlig en langstrakt, svag, retlinet Lysstribe *ved Siden* af Hovedhalen, saaledes at den paa en Maade tangerede Hovedhalen ved dens Ud-

* "*Results of Astronomical Observations*, London, 1847, Plate XV. Fig. 3."

spring.* Jeg har i disse, rigtignok aldrig ret klare Aftener ikke seet Noget til Sidehalen, men om den ovenfor beskrevene, efter al Rimelighed ikkun meget kortvarige Hale, som altsaa har været den tredie, kan der aldeles ikke være nogen Tvivl. Det er forresten almindeligt bekjendt, at den store Komet af Aaret 1843 Udskœd endnu længere Lysstriber, medens den Komet, der kom tilsyne Aaret 1744 viste sig nogen Tid vifteagtig med ikke mindre end sex forskjellige Haler."

It is remarkable that in this feature D'Arrest's figure has an evident resemblance to two received from R. L. J. Ellery, Esq., of Williamstown, Australia, for the dates October 12th and 14th, copies from which are here inserted.

Fig. 6.

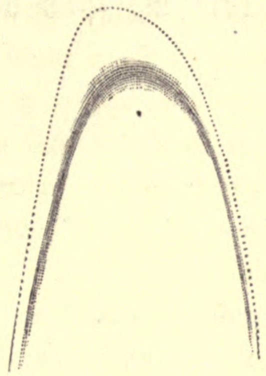
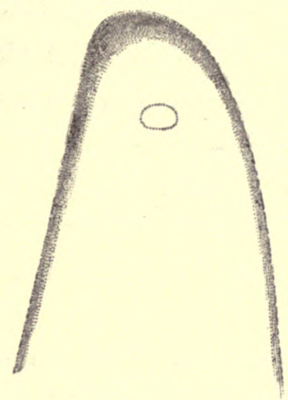


Fig. 7.



GÖTTINGEN. LISTING. (*Astron. Nachrichten*, 1167, p. 231.)

"Es kam nur bei Betrachtung des Cometen mit freiem Auge vor, wie wenn sich auf der linken Seite ein freilich sehr matter und kaum erkennbarer gradliniger und sehr schmaler Zweig zeigte. Ich hielt es diesen Abend für eine Täuschung, vielleicht erzeugt durch mehrere in dieser Richtung vorhandene Sterne von geringen Grössenordnungen, die dem freien Auge nicht mehr einzeln erkennbar, den gedachten äusserst schwachen Lichtschimmer hervorbrachten."

1858. September 30. (Plates VIII. and XXIV.)

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 7, 8.)

"Heute wurde, zum ersten Mal mit blossem Auge, deutlich ein mit dem Hauptschweife einen spitzen Winkel bildender schmaler Nebenschweif gesehn, welcher um $20^h\ 20^m$ Sternzeit gerade auf η Ursæ Maj. gerichtet war, und auch bis in die Nachbarschaft dieses Sterns verfolgt werden konnte. Seine hellste Stelle hatte er nicht etwa auf dem Punkte, wo er von dem Hauptschweife abzweigte sondern etwa auf ein Drittel der Entfernung von demselben bis η

* "Jvfr. Tegningen hos *Bond, Account of Donati's Comet*, p. 15, Fig. 9, og blandt Andet hvad Professor *Listing* i Göttingen desangaaende meddeler i *Astron. Nachr.*, Bd. XLIX. p. 231."

Ursæ. Seine Breite verändert er nur sehr wenig in der ganzen Ausdehnung. . . . . . Die Stelle der nachfolgenden Begränzung des Schweifs, deren Position durch AR = 13^h 15^m 59^s, Decl. = + 37° 59′ gegeben ist, bezeichnet nahezu den Ort, wo der auf η Ursæ Maj. gerichtete Nebenschweif seinen Anfang nimmt."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 32.)

	α 1800.0	δ 1800.0	
"Endpunkt der Mitte des schwachen Schweifes	200° 36′	+42° 2′	Breite 16′.
Coordinaten der Mitte	198 29	36 0	
	199 12	38 0	
	199 52	40 0	
Absprossungspunkt vom Hauptschweife:	197 8	+33 9	

Länge des Schweifes fürs blosse Auge 19°."

A chart accompanies the above.

1858. October 1. (Plates IX. and XXIV.)

GÖTTINGEN. AUWERS. (*Astron. Nachrichten*, 1167, pp. 235, 236.)

"Eine interessante Erscheinung, ein zweiter Schweif, ist an diesem Cometen, so viel mir bis jetzt bekannt ist, nur an zwei Orten beobachtet. Ich erlaube mir daher, einige Bemerkungen über diesen Nebenschweif aus dem Beobachtungsjournal auszuziehen. Oct. 1 sah ich zuerst, dass sich etwa 3° vom Kern entfernt von der convexen Südgrenze des Hauptschweifs ein schwacher geradliniger Streifen trennte, welcher an dieser Stelle eine Breite von etwa $\frac{1}{4}$°, am Ende von etwa 1° hatte, und 8^h 3^m m. Zt. zwischen η Ursæ und λ Boötis hindurch bis ι Boötis, also 27° weit ging, während die Länge des Hauptschweifs an diesem Tage 21° betrug."

GÖTTINGEN. LISTING. (*Astron. Nachrichten*, 1167, pp. 232–234.)

"Am 1^{sten} October richtete ich mein Augenmerk besonders auf den erwähnten Seitenzweig des Cometenschweifs und ich glaubte nunmehr mit Bestimmtheit annehmen zu dürfen, dass dessen Vorhandensein nicht auf Täuschung beruhe. Der sehr brillante gekrümmte Haupttheil des Schweifs, dessen Ausdehnung ich auf 23° schätzte, so wie die Breite auf etwa 4° an der ungefähr 15 bis 18 Grad vom Kopf entfernten Gegend, zeigte zur Linken eine sehr zarte, lichtschwache Abzweigung, welche in der Entfernung von 5° bis 6° vom Kopf aufwärts erst die Trennung von dem Hauptschweif einigermaassen deutlich erkennen liess, sich zu der linken Grenze des hellen Schweifs, welche merklich bestimmter begrenzt erschien als die rechte, wie einige geradlinige Tangente zur Curve verhielt und sich fast auf gleiche Länge wie der Hauptschweif erstreckte.

"Der Comet hatte in zwei Tagen seine Rectascension um etwa $2\frac{1}{2}$° geändert und so war es kaum denkbar, dass der Zufall auch in dieser neuen Stellung eine

Constellation sehr kleiner Sterne in die Nähe des Cometen gebracht haben sollte, durch deren matten Lichtschimmer dem Auge eine Täuschung der vorerwähnten Art sollte beigebracht worden sein. Der geradlinige Nebenzweig zielte (Octbr. 1 Abends 8^h) auf die kleine Sterngruppe in der linken Hand des Boötes, welche nordwestlich (oben links) von η Ursæ Maj. steht, etwa auf den Stern $\varkappa$, woraus hervorgeht, dass der fragliche sehr lichtschwache geradlinige Zweig des Schweifes nahe mit der Verlangerung der geraden Linie (grössten Kreises) zwischen Sonne und Cometenkern zusammenfiel. Herr Stud. *Auwers* und Herr Dr. *Klinkerfues*, die ich auf diese Specialität aufmerksam machte, traten meiner Meinung bei."

1858. October 2. (Plates X. and XXIV.)

Observatory of Harvard College. G. P. Bond.

Two sketches accompanied by the following remarks. "There is evidently a secondary tail or stream of light; it is not much, if at all, brighter near the principal tail." In the sketches it is only faintly indicated near its junction with the bright edge. At 8^h m. s. t. the axis of the faint ray reached nearly to λ Boötis, pointing a little above it; the least distance from that star to the axis prolonged was $1° \, 10'$.

1858. October 3. (Plates XI. and XXIV.)

Göttingen. Auwers. (*Astron. Nachrichten*, 1167, p. 236.)

"$7^h \, 5^m$ ging der Nebenschweif durch *A* Boötis (P 14.45), 33 und 38^h bis 44 ι und 47 $\varkappa$ Boötis, hatte also 30° Länge (der andre 26°); er war grade, blass und schmal, nur am Ende schien er etwas gebogen zu sein, und zwar in entgegengesetzten Richtung, wie der Hauptschweif, doch liess sich dies bei nebeliger Luft nicht sicher entschieden."

1858. October 4. (Plates XII. and XXIV.)

Göttingen. Auwers. (*Astron. Nachrichten*, 1167, p. 236.)

"$7^h \, 6^m$. Der Nebenschweif trennte sich von dem andern für das blosse Auge etwa bei δ Boötis und ging zwischen β und γ hindurch bis $228° + 49°$, war also 32° lang (der Hauptschweif 28°). Er war äusserst schwach, ganz grade und am Ende höchstens 1° breit."

Observatory of Harvard College. G. P. Bond.

"The secondary tail to-night is 35° long, though the sky is not by any means transparent. It is decidedly brighter than it was last evening. There seem to be two, forming together a regular, bifurcated tail."

1858. October 5. (Plates XIII., XIV., and XXIV.)

Observatory of Harvard College. G. P. Bond.

"The secondary tails were faint, evidently curved towards the principal tail, and from 50° to 60° long. A sketch of their appearance was made at $8^h \, 15^m$."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 9.)

"Der am 30ten Sept. bemerkte Nebenschweif wurde auch heute sehr deutlich gesehn. Um 20^h 15^m hatte er eine vollkommen verticale Richtung, indem er sich vom Hauptschweife an einer Stelle abzweigte die etwa einen halben Grad nach Norden von ε Boötis abstand."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 32.)

"Den zweiten Schweif sah ich heute zum ersten Male mit blossem Auge; er ging in der Mitte zwischen μ und β Boötis hindurch, war $20' - 30'$ breit, und stand, so weit sich beurtheilen liess, vertical.

	α 1840.0	δ 1840.0
"Punkt in der Axe:	226° 54′	+40° 0′

"Die Stelle wo seine Verlängerung den nachfolgenden Schweifrand traf, lag etwa 5° vom Kerne entfernt."

1858. October 6. (Plates XV. and XXIV.)

GÖTTINGEN. AUWERS. (*Astron. Nachrichten*, 1167, p. 236.)

"7^h 3^m. Der grade, sehr blasse Nebenschweif trennte sich von dem andern in der Mitte zwischen ψ und α Boötis, und ging etwas nördlich an μ und ν Boötis vorbei bis zum 50 Parallel, war also 40° lang (Hauptschweif 34°)."

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

One of the secondary tails, 55° long, reached to 80, 81, and 85 Herculis, or to a point 3° south of γ Draconis. Its place, with that of two or three others imperfectly indicated, was entered on a sketch.

OBSERVATORY OF HARVARD COLLEGE. TUTTLE.

A sketch of the secondary tail and of several streamers in the upper part of the tail. The principal ray passed between the stars ω, ψ, b, and c Boötis, and close to the right hand of the latter star.

MÜNSTER. HEIS. (*Astron. Nachrichten*, 1169, p. 270.)

"An diesem Abende bemerkte ich ganz deutlich, was mir schon seit Anfang des Monats aufgefallen war, dass die äussere convexe Seite des Schweifes in der Begrenzungscurve gleichsam einen Bruch, einen Knick zeigte, gleichsam als habe sich von dem Schweife irgend ein Theil gelös't, der stärker hervortrete. Diese Stelle fand ich am 6ten deutlich zwischen δ und ε Boötis bei 220° Rectascension und +31° Declination, etwa in der Mitte der Curve. Diese Anomalie der Begrenzungscurve bemerkte ich zwar noch am 8ten September [October ?], am 9ten aber war sie verschwunden."

1858. October 7. (Plates XVI. and XXIV.)

GÖTTINGEN. AUWERS. (*Astron. Nachrichten*, 1167, p. 237.)

"7^h 9^m. Der zweite Schweif streifte mit seiner südlichen Grenze α Coronæ fast, liess sich aber nicht mit Sicherheit weiter verfolgen; Luft neblig."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 11.)

"Der Nebenschweif ging einen halben Grad nördlich bei α Coronæ vorbei und erstreckte sich durch das ganze Sternbild der Corona."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 32.)

"20^h 15^m. Der schwache Schweif geht fürs blosse Auge $\frac{3}{4}°$ rechts von α Coronæ vorbei."

1858. October 8. (Plates XVII. and XXIV.)

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"The long streamer always seen."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 33.)

"Den zweiten Schweif konnte ich durchaus nicht wahrnehmen."

1858. October 9.

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

A sketch showing the two secondary tails. Length of principal ray 45°? A sketch of one of them was also made by Mr. H. G. Fette.

1858. October 10. (Plates XIX. and XXIV.)

GÖTTINGEN. AUWERS. (*Astron. Nachrichten,* 1167, p. 237.)

"6^h 5^m. Der Nebenschweif war zwar blass, aber deutlich bis in die Nähe von δ Herculis zu verfolgen, seine Länge betrug also 39°, eben so viel wie die des Hauptschweifs. Er war auf der Nordseite schärfer begrenzt."

ALTONA. PAPE. (*Astron. Nachrichten,* 1174, pp. 345, 346.)

"In Pulkowa ist von Herrn Dr. Winnecke, in Göttingen von Herrn Prof. Listing und Herrn Auwers noch ein gerader, schmaler und sehr schwacher Nebenschweif gesehen worden, der mir und vielen andern Beobachtern ganz entgangen ist. Nach den von den Herren Prof. Listing und Auwers gegebenen Beschreibungen in No. 1167 der A. N. lag dieser Schweif nahezu in der Verlängerung des Rad. Vector; die ihn bildenden Theilchen müssten also einer äusserordentlich starken abstossenden Kraft der Sonne unterworfen sein. . . . . . Für den Endpunkt des Schweifes habe ich aus jenen Angaben folgende Bestimmungen entnommen: —

M. B. Z.	α 1858.0	δ 1858.0
Oct. 1.350	210° 30′	+52° 0′
4.322	228 9	48 57
10.278	257 11	+24 58

". . . . . Für den 10^{ten} Octbr. liegt mir eine von Herrn Auwers mitgetheilte Zeichnung des Schweifes vor, in der die Breite desselben an seinem Ende etwa einen Grad beträgt."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 48. 49.)

"Das Wahrnehmen der schwachen Umhüllung am 16 Sept. führte mich auf die Idee, ob sie vielleicht die erste Spur der Entwickelung eines zweiten Schweifes sei, in der der Sonne zugewandten Richtung, eine Erscheinung, die so viel mir bekannt, nur bei den Cometen von 1680, 1824, 1845 und 1851 wahrgenommen ist. Die Folge davon war ein sorgsames Untersuchen der Nachbarschaft des Cometen in Bezug auf sehr schwache Schweifspuren, das allerdings zu einem negativen Resultate für jene erste Idee führte, aber Veranlassung wurde zur Auffindung eines schmalen, schwachen Ausläufers aus dem Hauptschweife, dessen Existenz sich am 18 und 19 Sept. bestätigte.

"Die Lichtstärke des neuen Schweifes war in seiner ganzen Ausdehnung ziemlich gleich; auch senkrecht auf die Axe konnte kein deutlicher Unterschied der Helligkeit bemerkt werden, weder damals, noch später, als er sich zugleich mit dem Hauptschweife zu enormer Länge ausgedehnt hatte. In unmittelbarer Nähe des Hauptschweifes war keine Spur von ihm zu sehen nach einstimmigem Zeugnisse der Gesammttheil der Beobachtungen, was wohl einfach der so erheblich grössern Lichtstärke jenes zuzuschreiben ist, welche den überhaupt kaum wahrnehmenbaren Schein in grösser Nähe auslöschte. Verlängert man die Richtung des Nebenschweifes aber, so erhält man für die Entfernung des Absprossungspunktes vom Kopfe: —

Sept.	18	3°.9	Entf. = 1	5°.1
"	19	3.8	"	4.6
"	30	3.7	"	3.3
Oct.	5	5.0	"	3.2

"Es ist das Kleinerwerden des Abstandes des Punktes, wo von der Erde aus gesehen die beiden Schweife aus einander liefen, vom Kopfe, eine nothwendige Folge der veränderten Lage der Erde gegen die Ebene der Cometenbahn, wenn die Mittellinien beider Schweife als darin liegend ausgesehen werden. Am 18 Sept. stand die Erde dieser Ebene noch sehr nahe und einige Tage früher wäre es unter jener Voraussetzung ganz unmöglich gewesen, die beiden Schweife getrennt zu erblicken.

"Aus den Seite 29–33 angeführten Beobachtungen lassen sich die Positionswinkel p dieses Schweifes ableiten; s sei die zugehörige Entfernung des beobachteten Punktes im Schweife vom Kopfe, p_0 die Richtung zur Sonne um die Beobachtungszeit.

Sept. 18 . . .	$s = 7° 43'$ . .	$p = 354° 55'$
" 19 . .	7 25 . .	356 17
" 30 . . .	5 56 . .	14 27
" 30 . .	12 13 . .	14 1
Oct. 5 . . .	24 30 . .	29 46
" 7 . .	18 18 . .	43 38 "

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen*, 1858, pp. 52, 53.)

"Die Erscheinung von zwei oder mehren deutlich getrennten Schweifen, welche von der Sonne abgewandt sind, scheint eben so selten zu sein, als die schon erwähnten merkwürdigen Wahrnehmungen von der Sonne zugekehrten Cometenschweifen. Es liegt das wohl im Wesentlichen in der beträchtlichen Schwierigkeit, die Nebenschweife bei ihrer grossen Lichtschwäche wahrzunehmen, zumal die Cometen in der Zeit, wo diese Erscheinungen am leichtesten zu bemerken sein würden, meistens eine solche Lage zur Erde haben, dass sie in dunkler Nacht nicht beobachtet werden können. Ich bin überzeugt, dass man bei grösserer Aufmerksamkeit in Zukunft diese interessanten secundären Schweife öfter wahrnehmen wird. Wie leicht diese schwachen Scheine dem Beobachter entgehen, davon ist der geradlinige Schweif des Donati'schen Cometen Zeuge, über den, so viel mir bekannt, nur noch Beobachtungen aus Göttingen und Cambridge, U. S. vorliegen. Die Zertheilung des Hauptschweifes am obern Ende in October, der man den Namen von Nebenschweifen gegeben hat, ist von diesem, seit Mitte September wahrgenommenen, aber ohne Zweifel schon länger vorhandenen zweiten Schweife ein total verschiedenes Phänomen. Jene Zerspaltung der obern Partien des Schweifes, seine säulenartige Schichtung, wurde hier ebenfalls bemerkt. Siehe die Beob. Oct. 8 und 9.

"Bei dem grossen Cometen von 1811 findet sich ein zweiter Schweif nur von einem der vielen Beobachter, von Olbers erwähnt, der seit dem 9 October deutliche Spuren davon wahrnahm. Olbers geht auf seine Beobachtungen über die Schweiferscheinungen nur ganz beiläufig ein, und beschränkt sich hauptsächlich auf das, was der Kopf gezeigt hat, ein Umstand der sehr zu bedauern ist bei dem Werthe den diese Notizen haben würden. So sagt er nicht einmal, auf welcher Seite des Hauptschweifes er den Nebenschweif erblickt habe. Es lässt sich nur eine Vermuthung darüber ausstellen, indem er erwähnt, dass ihm die von Cheseaux gegebene Erklärung der winklichten Einbucht bei dem Cometen von 1744 * auf

* "Cheseaux, *Traité de la Comète*, etc., pag. 153. 'Je remarque encore, que cette espèce de coude, que j'avais aperçu dans la queue de la comète le 9 Janv. et quelques autres jours, n'était autre chose, que

den Cometen von 1811 zu passen schiene, der auf der rechten (nachfolgenden) Seite eine analoge Erscheinung gezeigt habe. Es wurde aber der zweite Schweif bei dem prächtigen Cometen von 1744 auf der nachfolgenden Seite (der wahren Bewegung nach) wahrgenommen.

"Bei dem Cometen von 1577 hat Cornelius Gemma vom 28 Nov. an mehrfach einen zweiten Schweif wahrgenommen* der, wie die beiden eben besprochenen, beträchtlich mehr zurückgebeugt war, als der Hauptschweif, so dass die Sonnenkraft eine erheblich kleinere für ihn sein musste, als für diesen. Die einzige, dem schmalen Schweife des Donati'schen Cometen völlig entsprechende Erscheinung, ist die des Cometen von 1807. Er zeigte einen geraden, schmalen und schwachen Schweif, bei weitem weniger zurückgebeugt als der gekrümmte hellere und übertraf den Hauptschweif an Länge, wie es bei unserm Cometen gleichfalls stattfand. Auch der Comet von 1843 hat nach indischen Berichten am 11 März zwei Schweife gehabt. Der neue war fast doppelt so lang, aber schwächer als der seit März 6 gesehene ältere Schweif; die Nachricht ist aber so unvollkommen, dass man nicht einmal mit Bestimmtkeit daraus ableiten kann, auf welcher Seite des Hauptschweifes sich dieser Ausläufer gezeigt hat. Vierzehn Tage später war der Nebenschweif nicht wahrnehmbar, falls die Mittellinie beider Schweife, wie zu vermuthen ist, in der Bahnebene des Cometen lag, so dass man in Europa eine derartige Erscheinung nicht bemerken konnte."

The great Comet II. of 1861, like that of 1858, had two principal tails, one strongly curved, the other narrow and nearly straight. There was a remarkable difference in the fact, that with the former the straight ray was by far the most conspicuous of the two, while in the Comet of 1858 it was faint and easily overlooked.

cette seconde queue, qui dans ses commencements était beaucoup moins séparée de la première.' Man kann eine Erklärung aus ähnlichen Gründen auch für einen am Cometen von 1858 bemerkten Knick gelten lassen. Siehe Beobachtungen von Heis. *Astr. Nachr.* No. 1169."

* "Beschreibung und Abbildung pag. 26 seiner Schrift; *De prodigiosa specie naturaque cometæ, etc., anni* 1577."

III. REDUCTION OF OBSERVATIONS UPON THE FIGURE AND POSITION OF THE TAIL.

The normal outlines of the tail contained in the charts on Plates XXIV., XXV., and XXVI. Sections I., II., and III., represent the final results deduced from the whole series of observations between September 16th and October 17th, referred to the common epoch, for each date, of 7^h mean solar time at the Observatory of Harvard College. The principal steps of the process by which they have been investigated will now be explained.

The observations having been collected and arranged under their proper dates, for convenience in reference, a provisional chart was constructed, showing the path of the Comet and the position of the tail among the neighboring constellations. With the aid of this chart, errors or ambiguities in the observations could be recognized or explained, their significance more readily understood, and the whole subsequent discussion of the data conducted with greater intelligence and security.

The projection was extended over an area large enough to include, besides the part of the heavens actually occupied by the Comet during its apparition, the principal stars in the surrounding spaces, to which occasional references are met with in the notes. The limits of the path of the head of the Comet comprised an arc of a little less than 100° of a great circle, drawn through its position on the first and last dates of the series. The tail at no time reached farther than 55° in a direct line from this circle. The scale of the provisional chart was the same as that of Plate XXIV., but the outlines upon the latter are in other respects identical with those upon Plate XXVI.

A similar projection, differing only in the scale and in the extent of spherical surface represented, was followed for the charts on Plates XXIV., XXVI. Sections I., II., III., and for the chart of outlines on September 16, 17, 18, and 19, Plate XXV.

The figure of the tail is presented free from considerable distortion, through the entire interval covered by the dates of observation, and without interruption of the continuity of the projection. This was effected in the following way.

Let a great circle be drawn through two points of the celestial sphere A and A′, of which the co-ordinates are

For A.	Right ascension	70° 00′	Mean Equinox 1858.0.
	Declination	0 00	" "
For A′.	Right ascension	160 00	" "
	Declination	+45 00	" "

The arc of this circle, comprised between 170° and 265° of right ascension, will intersect the front edge of the tail of the Comet, or its prolongation, between the dates September 16 and October 17, at the following inclinations and distances from the nucleus: —

1858. Sept. 17	Inclination 119°	Distance 7°.7
24	110	7 .0
Oct. 1	105	8 .6
8	91	12 .0
15	73	15 .5

The angles of inclination are included between A A′ and a great circle drawn from the point of intersection to the nucleus, and are counted from the side preceding in right ascension towards the nucleus. They indicate, quite nearly, the general direction of the tail between the nucleus and that point.

If we suppose the sphere to be developed upon a tangent cylinder, of which the axis is perpendicular to the plane of the great circle A A′, a favorable representation will be obtained of the regions through which the tail passed. The choice of the position of the circle A A′, which may be called the equator of projection, has been, within certain limits, arbitrary; but it was thought best to adopt one which should secure almost entire freedom from distortion in the bright part of the tail, that is, for the first 20° or 30° of its length, where the outlines were comparatively definite.

Observations on the principal tail do not extend beyond a distance of 33° from the equator of projection, and by far the greater part are within 20°. The latter limit comprises the part of the tail distant less than 33° from the nucleus, beyond which observations are liable to such large uncertainties as to make the small marginal enlargement of the projection of little moment in comparison.

The circle A A′ has been adopted for the equator of projection in all the charts, excepting that of the Light-axis, October 8, on Plate XXV. The development upon the cylinder has been a little modified by a process similar to *Mercator's* projection of an equatorial zone, the secondaries to A A′ in the one case corresponding to circles of latitude in the other. Such a zone, extending in width from about 10° of south latitude to 20° of north latitude, would present, on *Mercator's* projection, the same amount of distortion which has place in the region of

the charts occupied by that portion of the tail lying within 33° of the nucleus. Between the equator and this limit, the scale increases in the proportion

$$\frac{\text{sec. } 20^\circ}{\text{sec. } 0^\circ} = 1.064,$$

or about one sixteenth part. The great enlargement of scale which obtains for districts very remote from the equator scarcely shows itself as an objectionable feature upon the narrow zone requiring to be represented.

The projection admits of representing the entire series of outlines, referred to one system of co-ordinates, and without interrupting the continuity of the projection; at the same time there is comparatively little distortion or change of scale throughout the area occupied by the Comet in all parts of its course. The angles of position of neighboring points, and the forms of small districts, are also strictly preserved. As the scale for small arcs is uniform in all directions from a given point, it is practically a convenience to be able to measure small distances, by using for the scale an arc of a circle of declination passing midway between the points whose distance is to be ascertained, and bisected by the arc joining them.

As far as a distance of 15° or 20° from the head of the Comet, the distortion in any direction is scarcely perceptible on the scale to which the charts are drawn.

For the chart of the Light-axis, October 8, Plate XXV., the region represented has been developed upon a cylinder tangent to a great circle in the right ascension 230°. Arcs of great circles perpendicular to the tangent circle are here represented without distortion.

To project the circles of right ascension and declination, referred throughout to the mean equinox for 1858.0, their intersections for every ten degrees, and, for the more important part of the chart, for every five degrees, were referred to the equator of projection by means of the following formulæ: —

$$\begin{aligned} \sin.\ \delta &= \sin.\ \mu \sin.\ \gamma & \sin.\ \beta &= \sin.\ \mu \sin.\ (\gamma - \varepsilon) \\ \sin.\ \alpha \cos.\ \delta &= \sin.\ \mu \cos.\ \gamma & \sin.\ \lambda \cos.\ \beta &= \sin.\ \mu \cos.\ (\gamma - \varepsilon) \\ \cos.\ \alpha \cos.\ \delta &= \cos.\ \mu & \cos.\ \lambda \cos.\ \beta &= \cos.\ \mu \end{aligned}$$

where

$$\alpha = \text{AR.} - 70^\circ, \qquad \delta = \text{Declination}, \qquad \varepsilon = 45^\circ.$$

The values of λ and β are given in the following tables: —

Values of λ and β used in projecting the Chart on Plate XXVI.

Declination.	AR. 165°. λ	AR. 165°. β	AR. 170°. λ	AR. 170°. β	AR. 175°. λ	AR. 175°. β	AR. 180°. λ	AR. 180°. β	Declination.
+35°	94° 9.3'	—9° 52.3'	98° 17.5'	— 9° 29.3'	102° 23.4'	— 8° 51.2'	106° 26.0'	— 7° 58.4'	+35°
40	93 50.5	—4 52.9	97 40.1	— 4 31.5	101 27.8	— 3 56.3	105 12.7	— 3 7.4	40
45	93 32.0	+0 6.5	97 3.2	+ 0 26.1	100 32.9	+ 0 58.6	104 0.3	+ 1 46.0	45
50	. . .	. . .	96 26.2	5 23.1	99 37.7	5 53.6	102 47.1	6 34.7	50
55	. . .	. . .	95 48.6	+10 21.5	98 41.6	10 48.3	101 32.7	11 25.6	55
60	. . .	. . .	. . .	. . .	97 43.5	+15 43.0	100 15.7	16 16.1	60
+65	. . .	. . .	. . .	. . .	. . .	. . .	98 54.7	+21 6.2	+65

Declination.	AR. 185°. λ	AR. 185°. β	AR. 190°. λ	AR. 190°. β	AR. 195°. λ	AR. 195°. β	AR. 200°. λ	AR. 200°. β	Declination.
	° '	° '	° '	° '					
+25°	. . .	. . .	. . .	. . .	122° 15.2'	—13° 4.1'	126° 24.8'	—11° 4.5'	+25°
30	111 56.5	—11 37.3	116 6.0	—10 10.9	120 9.0	8 30.9	124 5.1	6 38.1	30
35	110 24.4	6 51.4	114 17.9	5 30.6	118 5.7	— 3 57.0	121 48.0	— 2 11.0	35
40	108 54.1	— 2 5.2	112 31.4	— 0 50.2	116 4.0	+ 0 37.1	119 31.4	+ 2 13.0	40
45	107 24.4	+ 2 41.1	110 45.2	+ 3 50.5	114 2.0	5 11.3	117 14.1	6 43.1	45
50	105 54.0	7 27.4	108 57.1	8 31.0	111 58.1	9 45.0	114 54.4	11 9.5	50
55	104 21.6	12 13.1	107 7.9	13 10.7	109 50.8	14 18.0	112 30.2	15 34.6	55
60	102 45.8	16 58.4	105 13.5	17 49.7	107 38.3	18 49.8	109 59.7	19 58.3	60
65	101 5.4	21 43.0	103 13.1	22 27.7	105 18.4	23 20.0	107 20.7	24 19.6	65
70	99 17.4	+26 26.4	101 4.3	27 4.0	102 48.4	27 47.9	104 30.4	28 38.0	70
+75	. . .	. . .	98 44.5	+31 38.1	100 6.4	+32 13.0	101 25.5	+32 52.5	+75

Declination.	AR. 205°. λ	AR. 205°. β	AR. 210°. λ	AR. 210°. β	AR. 215°. λ	AR. 215°. β	AR. 220°. λ	AR. 220°. β	Declination.
	° '	° '	° '	° '	° '	° '			
+ 5°	. . .	. . .	. . .	. . .	. . .	. . .	154° 22.4'	—16° 53.6'	+ 5°
10	. . .	. . .	. . .	. . .	147 5.0	—16 3.6	151 5.5	13 1.6	10
15	. . .	. . .	139 56.9	—14 50.1	144 0.3	12 2.9	147 54.6	9 7.2	15
20	133 2.1	—13 10.8	137 6.0	10 40.6	141 1.0	8 0.3	144 48.0	5 11.2	20
25	130 26.3	8 52.6	134 19.6	6 29.6	138 5.2	— 3 56.6	141 43.6	— 1 14.2	25
30	127 54.1	4 33.4	131 36.0	— 2 18.0	135 11.2	+ 0 8.0	138 39.8	+ 2 42.8	30
35	125 23.7	— 0 14.0	128 53.5	+ 1 54.4	132 17.1	4 12.4	135 34.8	6 39.5	35
40	122 53.6	+ 4 6.0	126 10.1	6 6.3	129 21.2	8 16.2	132 26.8	10 35.0	40
45	120 21.7	8 25.2	123 24.2	10 17.3	126 21.5	12 18.6	129 12.9	14 28.7	45
50	117 46.3	12 43.5	120 33.8	14 27.2	123 16.4	16 9.1	125 54.1	18 19.3	50
55	115 5.7	17 0.2	117 36.8	18 34.4	120 3.6	20 16.7	122 25.4	22 6.8	55
60	112 17.6	21 14.7	114 31.3	22 39.1	116 40.6	24 10.7	118 45.2	25 49.4	60
65	109 19.5	25 26.4	111 14.4	26 39.9	113 5.0	28 0.0	114 51.0	29 26.1	65
70	106 8.7	29 34.0	107 43.3	30 35.9	109 13.8	31 43.1	110 39.8	32 55.5	70
75	102 41.7	33 36.8	103 54.5	34 25.7	105 3.5	35 18.7	106 8.4	+36 15.8	75
+80	98 54.6	+37 33.4	99 44.1	+38 7.7	100 30.5	+38 45.0	. . .	. . .	+80

Values of λ and β used in projecting the Chart on Plate XXVI. (*Concluded.*)

Declination.	AR. 225°. λ	AR. 225°. β	AR. 230°. λ	AR. 230°. β	AR. 235°. λ	AR. 235°. β	AR. 240°. λ	AR. 240°. β	Declination.
°	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	°
—15	. . .	. . .	. . .	. . .	. . .	. . .	183 52.4	—17 33.3	—15
10	. . .	. . .	. . .	. . .	176 32.6	—17 38.4	180 6.6	14 6.2	10
— 5	. . .	. . .	169 9.4	—17 36.7	172 51.1	14 7.2	176 27.6	10 36.0	— 5
0	161 45.1	—17 23.2	165 34.0	13 59.7	169 16.3	10 32.7	172 53.6	7 3.2	0
+ 5	158 17.9	13 39.2	162 5.3	10 19.7	165 46.5	6 55.9	169 22.8	— 3 29.4	+ 5
10	154 57.2	9 52.5	158 41.5	6 37.4	162 19.9	— 3 17.6	165 53.7	+ 0 6.4	10
15	151 41.1	6 3.8	155 20.7	— 2 54.0	158 54.8	+ 0 21.4	162 24.4	3 41.6	15
20	148 27.8	— 2 14.0	152 1.3	+ 0 50.0	155 29.5	4 0.4	158 53.6	7 15.9	20
25	145 15.4	+ 1 36.4	148 41.3	4 34.5	152 2.4	7 38.4	155 19.3	10 48.6	25
30	142 2.4	5 26.2	145 19.5	8 17.7	148 31.7	11 14.9	151 40.0	14 18.8	30
35	138 46.9	9 15.1	141 53.6	11 58.4	144 55.8	14 48.7	147 53.6	17 45.7	35
40	135 26.9	13 2.2	138 22.2	15 37.2	141 12.7	18 19.2	143 58.7	21 7.7	40
45	132 1.1	16 46.7	134 43.2	19 12.4	137 20.4	21 45.1	139 52.3	24 24.4	45
50	128 26.8	20 27.7	130 54.4	22 43.2	133 16.8	25 5.4	135 34.1	27 34.0	50
55	124 42.4	24 4.0	126 53.8	26 8.2	129 0.0	28 18.6	131 0.7	30 35.0	55
60	120 44.8	27 34.7	122 39.1	29 26.2	124 27.4	31 23.4	126 9.6	33 26.0	60
65	116 32.0	30 58.1	118 7.4	32 35.5	119 36.8	34 18.0	120 59.8	36 5.0	65
70	112 1.0	34 12.7	113 16.5	35 34.4	114 26.2	+37 0.3	115 29.5	+38 29.8	70
+75	107 8.7	+37 16.6	108 4.0	+38 20.8	. . .	. . .	. . .	. . .	+75

Declination.	AR. 245°. λ	AR. 245°. β	AR. 250°. λ	AR. 250°. β	AR. 255°. λ	AR. 255°. β	AR. 260°. λ	AR. 260°. β	Declination.
°	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	°
—15	187 18.8	—14 2.2	. . .	. . .	. . .	. . .	. . .	. . .	—15
10	183 37.2	10 34.3	. . .	. . .	. . .	. . .	. . .	. . .	10
— 5	180 0.8	7 4.0	183 32.4	— 3 31.6	187 4.0	— 0 8.0	. . .	. . .	— 5
0	176 27.6	— 3 32.0	180 0.0	0 0.0	183 32.4	+ 3 32.0	. . .	. . .	0
+ 5	172 56.0	+ 0 0.7	176 27.6	+ 3 31.6	179 59.2	7 4.0	183 32.4	+10 36.0	+ 5
10	169 24.4	3 33.6	172 53.6	7 3.2	176 22.7	10 34.3	179 53.4	14 6.7	10
15	165 51.2	7 5.6	169 16.3	10 32.7	172 41.3	14 2.1	176 7.6	17 33.3	15
20	162 14.6	10 35.9	165 34.0	13 59.7	168 53.0	17 26.5	172 13.1	20 56.0	20
25	158 33.2	14 3.7	161 45.0	17 23.3	164 56.3	20 46.4	168 8.0	24 12.7	25
30	154 44.9	17 28.1	157 47.5	20 42.3	160 48.6	24 1.0	163 50.3	27 22.5	30
35	150 48.0	20 48.0	153 39.5	23 55.3	156 29.0	27 8.0	159 17.4	30 24.5	35
40	146 40.6	24 2.1	149 19.0	27 2.0	151 54.6	30 7.0	154 27.5	33 16.4	40
45	142 20.6	27 9.4	144 44.1	30 0.0	147 3.6	32 55.6	149 19.1	+35 55.9	45
50	137 46.0	30 8.2	139 52.7	32 48.0	141 54.3	+35 32.4	143 50.0	. . .	50
55	132 55.0	32 56.8	134 43.1	35 24.0	. . .	. . .	. . .	. . .	55
60	127 45.3	35 33.6	129 13.9	+37 45.7	. . .	. . .	. . .	. . .	60
+65	122 15.8	+37 55.6	. . .	. . .	. . .	. . .	. . .	. . .	+65

Declination.	AR. 265°. λ	AR. 265°. β	AR. 270°. λ	AR. 270°. β	AR. 275°. λ	AR. 275°. β	Declination.
°	° ′	° ′	° ′	° ′	° ′	° ′	°
+ 5	187 8.9	+14 7.2	. . .	. . .	. . .	. . .	+ 5
10	183 27.3	17 38.3	187 6.4	+21 9.5	. . .	. . .	10
15	179 47.0	21 5.3	183 11.4	24 37.3	186 52.8	+28 8.6	15
20	175 35.9	24 26.8	179 3.2	27 58.6	182 37.3	31 30.7	20
25	171 21.8	27 41.5	174 39.4	31 12.0	178 2.9	+34 43.6	25
30	166 52.5	30 48.1	169 57.6	+34 15.8	. . .	. . .	30
+35	162 5.6	+33 44.7	. . .	. . .	. . .	. . .	+35

Values of λ and β used in projecting the Chart on Plate XXIV.

Declination.	AR. 40°. λ	AR. 40°. β	AR. 50°. λ	AR. 50°. β	AR. 60°. λ	AR. 60°. β	AR. 70°. λ	AR. 70°. β	Declination.
+10°	345° 11′	+28° 7′	352° 54′	+21° 9′	0° 7′	+14° 7′	7° 6′	+ 7° 3′	+10°
20	353 40	35 2	0 57	27 59	7 47	20 56	14 26	14 0	20
30	3 48	41 21	10 2	34 16	16 10	27 22	22 12	20 42	30
40	15 35	46 27	20 31	39 46	25 33	33 16	30 41	27 2	40
50	29 26	48 4	32 36	44 12	36 10	38 21	40 7	32 48	50
60	47 32	52 12	46 17	47 10	48 13	42 21	50 46	37 46	60
+70	61 23	+51 45	61 5	+48 21	61 35	+44 57	62 46	+41 38	+70

Declination.	AR. 80°. λ	AR. 80°. β	AR. 90°. λ	AR. 90°. β	AR. 100°. λ	AR. 100°. β	AR. 110°. λ	AR. 110°. β	Declina-nation.
+10°	14° 6′	+ 0° 6′	21° 19′	— 6° 37′	28° 55′	—13° 2′	37° 6′	—18° 57′	+10°
20	21 6	7 16	27 59	+ 0 50	35 12	— 5 11	42 54	10 41	20
30	28 20	14 19	34 41	8 18	41 20	+ 2 43	48 54	— 2 18	30
40	36 1	21 8	41 38	15 37	47 33	10 35	53 50	+ 6 6	40
50	44 26	27 34	49 6	22 43	54 6	18 19	59 26	14 27	50
60	53 50	33 26	57 21	29 26	61 15	25 49	65 29	22 39	60
+70	64 31	+38 30	66 44	+35 34	69 20	+32 55	72 17	+30 36	+70

Declination.	AR. 120°. λ	AR. 120°. β	AR. 130°. λ	AR. 130°. β	AR. 140°. λ	AR. 140°. β	AR. 150°. λ	AR. 150°. β	Declination.
+10°	46° 3′	—24° 15′	55° 51′	—28° 42′	66° 34′	—32° 7′	78° 3′	—34° 16′	+10°
20	51 11	15 30	60 6	19 29	69 39	22 9	79 41	24 22	20
30	55 55	— 6 38	63 54	10 10	72 19	12 49	81 4	14 27	30
40	60 29	+ 2 13	67 29	— 0 50	74 47	— 3 7	82 20	— 4 31	40
50	65 6	11 9	71 3	+ 8 31	77 13	+ 6 35	83 34	+ 5 23	50
60	70 0	19 58	74 46	17 50	79 44	16 16	84 50	15 19	60
+70	75 30	+28 38	78 56	+27 4	82 32	+25 55	86 14	+25 14	+70

Declination.	AR. 160°. λ	AR. 160°. β	AR. 170°. λ	AR. 170°. β	AR. 180°. λ	AR. 180°. β	AR. 190°. λ	AR. 190°. β	Declination.
+10°	90° 0′	—35° 0′	101° 56′	—34° 16′	113° 26′	—32° 7′	124° 9′	—28° 42′	+10°
20	90 0	25 0	100 19	24 22	110 21	22 9	119 54	19 29	20
30	90 0	15 0	98 56	14 27	107 41	12 49	116 6	10 10	30
40	90 0	— 5 0	97 40	— 4 31	105 13	— 3 7	112 31	— 0 50	40
50	90 0	+ 5 0	96 26	+ 5 23	102 47	+ 6 35	108 57	+ 8 31	50
60	90 0	15 0	95 10	15 19	100 16	16 16	105 13	17 50	60
+70	90 0	+25 0	93 46	+25 14	97 28	+25 55	101 4	+27 4	+70

Values of λ and β used in projecting the Chart on Plate XXIV. (*Concluded.*)

Declination.	AR. 200°. λ	AR. 200°. β	AR. 210°. λ	AR. 210°. β	AR. 220°. λ	AR. 220°. β	AR. 230°. λ	AR. 230°. β	Declination.
—30°	. . .	. . .	. . .	. . .	. . .	. . .	190° 3′	—34° 16′	—30°
20	. . .	. . .	. . .	. . .	173 40	—35 2	180 57	27 59	20
—10	. . .	. . .	156 42	—34 47	165 12	28 6	172 54	21 10	—10
0	139 53	—32 48	149 19	27 2	157 58	20 42	165 34	14 0	0
+10	133 57	24 15	142 54	18 57	151 5	13 2	158 41	— 6 37	+10
20	128 49	15 30	137 6	10 41	144 48	— 5 11	152 1	+ 0 50	20
30	124 5	— 6 38	131 6	— 2 18	138 40	+ 2 43	145 19	8 18	30
40	119 31	+ 2 13	126 10	+ 6 6	132 27	10 35	138 22	15 37	40
50	114 54	11 9	120 34	14 27	125 54	18 19	130 54	22 43	50
60	110 0	19 58	114 31	22 39	118 45	25 49	122 39	29 26	60
+70	104 30	+28 38	107 43	+30 36	110 40	+32 55	113 16	+35 34	+70

Declination.	AR. 240°. λ	AR. 240°. β	AR. 250°. λ	AR. 250°. β	AR. 260°. λ	AR. 260°. β	AR. 270°. λ	AR. 270°. β	Declination.
—20°	187° 47′	—20° 56′	194° 26′	—14° 0′	. . .	. . .	. . .	. . .	—20°
—10	180 7	14 6	187 6	— 7 0	194 6	— 0 6	. . .	. . .	—10
0	172 54	— 7 3	180 0	0 0	187 6	+ 7 3	194 26	+14 0	0
+10	165 54	+ 0 6	172 54	+ 7 3	179 53	14 7	187 6	21 9	+10
20	158 54	7 16	165 34	14 0	172 13	20 56	179 3	27 59	20
30	151 40	14 19	157 48	20 42	163 50	27 22	169 58	34 16	30
40	143 59	21 8	149 19	27 2	154 27	33 16	159 29	39 46	40
50	135 34	27 34	139 53	32 48	143 50	38 21	147 24	44 12	50
60	126 10	33 26	129 14	37 46	131 47	42 21	133 43	47 10	60
+70	115 29	+38 30	117 14	+41 38	118 25	+44 57	118 55	+48 21	+70

The following were used in a chart for a special investigation of the observations on the lower part of the tail, October 5th, 1858.

Declination.	AR. 210°. λ	AR. 210°. β	AR. 212°. λ	AR. 212°. β	AR. 214°. λ	AR. 214°. β	Declination.
+19°	137° 39′	—11° 31′	139° 16′	—10° 28′	140° 50′	—9° 22′	+19°
21	136 32	9 51	138 7	8 48	139 40	7 44	21
23	135 26	8 10	136 59	7 9	138 30	6 6	23
25	134 20	6 30	135 51	5 30	137 21	4 28	25
27	133 14	4 49	134 44	3 50	136 12	2 50	27
29	132 8	3 8	133 36	2 11	135 3	—1 11	29
+31	131 3	— 1 28	132 29	— 0 31	133 55	+0 27	+31

Declination.	AR. 216°. λ	AR. 216°. β	AR. 218°. λ	AR. 218°. β	AR. 220°. λ	AR. 220°. β	Declination.
+19°	142° 23′	— 8° 16′	143° 55′	— 7° 8′	145° 25′	—5° 59′	+19°
21	141 11	6 39	142 42	5 32	144 11	4 23	21
23	140 1	5 2	141 23	3 56	142 57	2 49	23
25	138 50	3 25	140 17	2 20	141 43	—1 14	25
27	137 39	1 48	139 5	— 0 45	140 30	+0 20	27
29	136 29	— 0 11	137 53	+ 0 52	139 16	1 55	29
+31	135 19	+ 1 26	136 41	+ 2 28	138 3	+3 20	+31

The chart on Plate XXIV. has been drawn to a scale of 300′ = 1^in., on the equator of projection, and Plate XXVI. Sections I., II., III. to a scale of 100′ = 1^in. For any point distant from this equator by an angle θ, the scale becomes, for Plate XXIV.,

$$300' = 1^{\text{in.}}.000 \text{ sec. } \theta.$$

For Plate XXVI.,

$$100' = 1^{\text{in.}}.000 \text{ sec. } \theta.$$

In constructing the original charts, a straight line was drawn, representing the projection of the equator of projection, and perpendicular to it, straight lines representing secondaries to the equator. The values of λ and β, after applying the usual correction from a table of meridional parts, gave the projections of the principal intersections of the circles of right ascension and declination. The curves were interpolated between the points by means of elastic rulers of holly-wood, $\frac{3}{16}$, $\frac{2}{16}$, and $\frac{1}{16}$ of an inch thick, and from two to four feet long. The rulers were placed on the chart and bent to the required curves by weights resting on the paper, set at suitable intervals, so as to secure as good a representation as possible of the projected points on either side of the arc to be drawn.

The next step was to project the places of the principal stars occurring within the area of the map. The positions of these, taken mostly from the *Uranometria Nova* of Argelander, are contained in the annexed catalogue.

Catalogue of Stars projected upon the Charts.

Name.	AR. 1858.0.	Dec. 1858.0.	Mag.	Name.	AR. 1858.0.	Dec. 1858.0.	Mag.
ζ Hydræ	131° 59′	+ 6° 29′	3.4	μ Leonis	146° 9′	+26° 40′	4
α Cancri	132 40	12 25	4	21 Leonis Minoris . .	149 46	35 56	4.5
10 Ursæ Majoris . .	132 52	42 21	4	η Leonis	149 53	17 28	3.4
κ Ursæ Majoris . .	133 29	47 43	3.4	15 Sextantis	150 10	0 18	4.5
ι Ursæ Majoris . .	134 50	64 6	5.4	α Leonis	150 12	12 40	1.2
θ Hydræ	136 45	2 55	4	λ Ursæ Majoris . .	152 8	43 38	3.4
38 Lyncis	137 30	37 25	4	ζ Leonis	152 11	24 8	3
40 Lyncis	138 6	35 0	3.4	γ Leonis	153 1	20 33	2
h Ursæ Majoris . .	140 4	+63 41	3.4	μ Ursæ Majoris . .	153 29	42 13	3
α Hydræ	140 11	— 8 3	2	30 Leonis Minoris . .	154 27	34 31	5.4
θ Ursæ Majoris . .	140 50	+52 20	3	31 Leonis Minoris . .	154 55	37 25	4.5
λ Leonis	140 54	+23 36	5.4	ρ Leonis	156 20	10 2	4
ι Hydræ	143 9	— 0 31	4.5	37 Leonis Minoris . .	157 40	32 42	5.4
ο Leonis	143 23	+10 32	4.3	46 Leonis Minoris . .	161 21	34 59	4
ε Leonis	144 25	24 25	3	54 Leonis	161 58	25 30	4.5
υ Ursæ Majoris . .	145 14	59 43	4.3	β Ursæ Majoris . .	163 18	57 8	2.3
φ Ursæ Majoris . .	145 38	+54 55	5.4	b Leonis	163 41	+20 56	4.5

Catalogue of Stars projected upon the Charts. (*Continued.*)

Name.	AR. 1858.0.	Dec. 1858.0.	Mag.	Name.	AR. 1858.0.	Dec. 1858.0.	Mag.
α Ursæ Majoris	163° 43′	+62° 31′	2	ν Boötis	205° 39′	+16° 30′	4.5
ψ Ursæ Majoris	165 25	45 16	3	Canum Venaticorum	206 12	35 29	7
δ Leonis	166 38	21 18	2.3	23H Canum Venaticorum	206 13	35 22	6
θ Leonis	166 44	+16 12	3.4	Canum Venaticorum	206 23	35 9	6
φ Leonis	167 22	— 2 53	5.4	η Boötis	206 59	19 6	3
ξ Ursæ Majoris	167 39	+32 20	4.3	τ Virginis	208 36	2 14	4
ν Ursæ Majoris	167 41	33 52	3.4	α Draconis	210 8	65 4	3.4
σ Leonis	168 27	6 48	4	42H Virginis	211 16	+ 3 5	5.4
ι Leonis	169 7	+11 19	4	κ Virginis	211 19	— 9 37	4.5
υ Leonis	172 25	— 0 2	5.4	κ Boötis	212 5	+52 27	4.5
59 Ursæ Majoris	172 41	+44 25	6	ι Virginis	212 8	— 5 19	4
ξ Virginis	174 29	9 3	5.4	α Boötis	212 17	+19 56	1
χ Ursæ Majoris	174 39	48 34	4	λ Boötis	212 44	46 45	4
ν Virginis	174 39	7 20	4.5	ι Boötis	212 46	+52 1	4.5
93 Leonis	175 9	21 0	4.5	λ Virginis	212 51	—12 43	5.4
β Leonis	175 26	15 22	2	*A* Boötis	212 59	+36 10	5
β Virginis	175 49	2 34	3.4	18H Boötis	214 6	9 6	5.4
γ Ursæ Majoris	176 36	54 29	2.3	θ Boötis	215 5	52 31	4.3
π Virginis	178 24	7 24	4.5	ρ Boötis	216 26	30 59	4.3
ο Virginis	179 30	9 31	4	γ Boötis	216 36	38 55	3.2
δ Ursæ Majoris	182 6	57 49	3.4	σ Boötis	217 8	30 22	5.4
η Virginis	183 10	0 7	3.4	π Boötis	218 30	17 1	4
14 Comæ Berenices	184 49	28 3	5.4	ζ Boötis	218 35	14 20	3.4
15 Comæ Berenices	184 57	29 4	4.5	31 Boötis	218 40	+ 8 46	5.4
29B Canum Venaticorum	185 9	42 8	6	μ Virginis	218 53	— 5 3	4
8 Canum Venaticorum	186 45	42 8	4.5	ο Boötis	219 39	+17 34	5.4
9 Canum Venaticorum	187 59	+41 39	6	ε Boötis	219 42	27 40	2.3
γ Virginis	188 37	— 0 40	3.2	109 Virginis	219 45	2 29	4.3
10 Canum Venaticorum	189 34	+40 3	6	ξ Boötis	221 12	19 41	4
ε Ursæ Majoris	191 56	56 44	2	ω Boötis	223 58	25 35	5.4
δ Virginis	192 7	4 10	3	β Boötis	224 10	40 57	3
12 Canum Venaticorum	192 21	39 5	3	ψ Boötis	224 36	27 31	4.5
ε Virginis	193 47	+11 43	3.2	c Boötis	225 16	25 26	5.4
θ Virginis	195 39	— 4 47	4.5	χ Boötis	227 8	29 42	5
42 Comæ Berenices	195 46	+18 15	4.5	δ Boötis	227 27	33 51	3
43 Comæ Berenices	196 19	28 35	4	η Coronæ Borealis	229 20	30 48	5
11H Canum Venaticorum	196 49	40 54	5	μ Boötis	229 47	37 52	4.3
20 Canum Venaticorum	197 47	41 19	5	ι Draconis	230 27	59 28	3
Canum Venaticorum	198 58	+44 39	6	β Coronæ Borealis	230 30	29 36	4.3
α Virginis	199 26	—10 25	1	ν^1 Boötis	231 28	41 19	4
ζ Ursæ Majoris	199 33	+55 40	2	ν^2 Boötis	231 41	41 23	4
147B Canum Venaticorum	200 3	46 46	6	θ Coronæ Borealis	231 48	31 50	4
ζ Virginis	201 51	0 8	3.4	δ Serpentis	232 0	11 1	3.4
17H Canum Venaticorum	202 7	37 55	5.6	α Coronæ Borealis	232 10	27 11	2
175B Canum Venaticorum	202 18	44 55	6	μ Coronæ Borealis	232 31	39 29	5
τ Boötis	205 8	18 9	5.4	φ Boötis	233 11	40 49	5
η Ursæ Majoris	205 28	+50 2	2	ζ Coronæ Borealis	233 30	+37 6	4

Catalogue of Stars projected upon the Charts. (*Concluded.*)

Name.	AR. 1858.0.	Dec. 1858.0.	Mag.	Name.	AR. 1858.0.	Dec. 1858.0.	Mag.
ι Serpentis	233° 48′	+20° 7′	5.4	λ Ophiuchi	245° 56′	+ 2° 17′	4.3
γ Coronæ Borealis .	234 11	26 44	4.3	β Herculis	246 1	21 48	2.3
α Serpentis	234 19	6 52	2.3	σ Herculis	247 22	42 44	4
λ Serpentis	234 53	7 48	4.5	16 Draconis	248 12	53 11	4.5
β Serpentis	234 54	+15 52	3.4	17 Draconis	248 13	53 13	4.5
μ Serpentis	235 33	— 2 59	3.4	42 Herculis	248 43	49 14	5.4
κ Serpentis	235 35	+18 35	4	ζ Herculis	248 59	31 52	3.2
δ Coronæ Borealis .	235 54	26 31	4.5	η Herculis	249 30	39 12	3
ε Serpentis	235 56	4 55	3.4	52 Herculis	251 16	46 14	4.5
κ Coronæ Borealis .	236 28	36 6	5.4	ι Ophiuchi	251 50	10 24	4.5
χ Herculis	236 56	42 51	4.5	κ Ophiuchi	252 44	9 36	3.4
γ Serpentis	237 28	16 8	4.3	ε Herculis	253 43	31 8	3.5
ε Coronæ Borealis .	237 56	27 18	4	μ Draconis	255 43	54 39	5.4
ι Coronæ Borealis .	238 56	30 15	5.4	α Herculis	257 2	14 34	var.
π Serpentis	239 2	23 12	5.4	ζ Draconis	257 6	65 53	3
υ Herculis	239 36	46 26	4.5	δ Herculis	257 18	25 1	3
θ Draconis	239 48	58 57	4.3	π Herculis	257 31	+36 59	3.4
κ Herculis	240 25	17 26	5	ν Serpentis	258 11	—12 43	5.4
τ Coronæ Borealis .	240 57	36 51	5.4	ρ Herculis	259 41	+37 17	4
φ Herculis	241 4	45 18	4	β Draconis	261 49	52 24	3.2
q Herculis	241 16	+17 2	6	α Ophiuchi	262 5	12 40	2
δ Ophiuchi	241 43	— 3 20	3	ν¹ Draconis	262 20	55 17	4
ε Ophiuchi	242 42	— 4 21	3.4	ν² Draconis	262 22	55 16	4
σ Serpentis	243 44	+ 1 22	5	ι Herculis	263 52	46 5	3.4
τ Herculis	243 52	46 39	3.4	μ Herculis	265 13	27 48	3.4
γ Herculis	243 55	19 29	3	ξ Draconis	267 46	56 53	3.4
ξ Coronæ Borealis .	244 8	31 13	5	θ Herculis	267 50	37 15	4
ν Coronæ Borealis .	244 16	34 5	5	ξ Herculis	268 3	29 15	4.3
ω Herculis	244 42	14 21	5	ν Herculis	268 16	30 12	4.5
η Draconis	245 31	+61 50	3.2	γ Draconis	268 18	+51 30	2.3

The places of the nucleus of the Comet at 7^h m. s. t., at the Observatory of Harvard College, derived from the ephemeris* on the following page, were next inserted on the charts.

The subjoined comparisons with observations show that the errors of the ephemeris will not be perceptible on the projections.

	$\Delta\alpha$ c — o	$\Delta\delta$ c — o
Sept. 12	— 0′.3	0′.0
Oct. 5	0.0	— 0.3
15	— 0.2	+ 0.3

* Interpolated from Searle's ephemeris, *Astron. Journal*, No. 120, pp. 189, 190.

Ephemeris of the Great Comet of 1858, *at* 7h *m. s. t. Observatory of Harvard College.*

1858.	α 1858.0.	δ 1858.0.	1858.	α 1858.0.	δ 1858.0.
Sept. 12	167° 46'.0	+36° 6'.5	Sept. 30	197° 57'.5	+29° 37'.4
13	168 43.0	36 13.3	Oct. 1	200 43.0	28 3.1
14	169 43.3	36 19.1	2	203 35.1	26 13.0
15	170 47.3	36 23.5	3	206 32.6	24 7.2
16	171 55.1	36 26.4	4	209 34.8	21 45.3
17	173 7.6	36 27.5	5	212 40.5	19 7.2
18	174 23.9	36 26.3	6	215 48.2	16 13.8
19	175 45.6	36 22.8	7	218 56.8	13 6.7
20	177 12.6	36 16.1	8	222 4.5	9 48.1
21	178 45.5	36 5.8	9	225 10.2	6 21.1
22	180 24.4	35 51.2	10	228 12.5	+ 2 49.2
23	182 10.1	35 31.7	11	231 10.4	— 0 43.7
24	184 2.7	35 6.5	12	234 2.7	4 14.0
25	186 2.5	34 34.3	13	236 49.0	7 38.4
26	188 10.0	33 55.4	14	239 28.6	10 54.3
27	190 25.2	33 7.3	15	242 1.3	13 59.6
28	192 48.3	32 9.2	16	244 26.7	16 53.1
29	195 19.1	+31 0.0	17	246 44.9	—19 34.4

The initial direction of the axis of the tail has been obtained from an ephemeris of the angles of position, at the nucleus, of the prolongation of the radius vector of the Comet seen from the Earth. To these angles normal corrections have been applied, derived from a provisional comparison with the observed directions of the initial axis. The numbers for 7h m. s. t., Observatory of Harvard College, as they were used in constructing the charts, are given below. p denotes the angle of position of the axis, p_0 that of the radius vector prolonged.

Ephemeris of the Angle of Position of the Initial Axis of the Tail.

	p_0	$p - p_0$	p
1858. Sept. 16	355° 46'	—0° 20'	355° 26'
17	356 20	0 37	355 43
18	357 2	0 55	356 7
19	357 52	1 14	356 38
20	358 51	1 30	357 21
21	350 58	1 47	358 11
22	1 15	2 4	359 11
23	2 43	2 20	0 23
24	4 23	2 35	1 48
25	6 17	2 52	3 25
26	8 25	—3 6	5 19

	p_0	$p-p_0$	p
1858. Sept. 27	10° 49′	—3° 20′	7° 29′
28	13 30	3 34	9 56
29	16 31	3 49	12 42
30	19 54	4 3	15 51
Oct. 1	23 40	4 16	19 24
2	27 52	4 28	23 24
3	32 30	4 41	27 49
4	37 37	4 53	32 44
5	43 9	5 3	38 6
6	49 3	5 15	43 48
7	55 11	5 24	49 47
8	61 23	5 35	55 48
9	67 27	5 44	61 43
10	73 10	5 53	67 17
11	78 21	6 2	72 19
12	82 56	6 11	76 45
13	86 51	6 19	80 32
14	90 9	6 27	83 42
15	92 52	6 34	86 18
16	95 3	—6 42	88 21

The directions of the initial axis having been entered upon the chart, the outlines of the tail within 10′ of the nucleus have been constructed by reducing to a proper scale the telescopic outlines, of which a full discussion will be given in another part of the volume. These having been originally drawn to a scale of $2' = 1^{\text{in.}}.000$, they required to be reduced in the proportion

$$\frac{2}{100 \text{ sec. } \theta} = 50 \cos.\ \theta$$

to adjust them to the scale of Plate XXVI., which is

$$100' \text{ sec. } \theta = 1^{\text{in.}}.000\,;$$

θ being the angular distance of the head of the Comet from the equator of projection. We have thus the proportions

Sept. 16	$\theta = 7°.8$	50 cos. θ = 49.5
20	7.2	" 49.6
24	7.0	" 49.6
28	7.3	" 49.6
Oct. 2	8.5	" 49.5
6	10.6	" 49.1
10	13.2	" 48.7
14	15.2	" 48.2

All the observations which could be used for constructing the tail were now inserted on the chart with the dates, places of observation, and occasionally with brief remarks annexed. In a few instances corrections for refraction have been applied, but they have not generally been sensible. Points near the nucleus, within 1° or 2° of it, were generally projected from it as an origin, to avoid any small error in relative position.

The observations may be divided into four classes: —

1.) Position of points either in the edges or in the axis, referred by description to neighboring stars.

2.) Directions of tangents similarly described.

3.) Determinations of the right ascension and declination of points in the tail.

4.) Drawings of the tail, for the most part as seen with the naked eye.

Of the latter class, the most valuable are those in which the stars have been also inserted. Where neither stars nor scale were given, the sketches could be used only for determining the amount of curvature and the relation of the two outlines to each other. In such cases the scales have been ascertained from the length and breadth of the tail in the figures, which were then enlarged to the same scale with the chart, and combined with the other data as circumstances would admit. It is to be regretted that the method of delineation upon star charts, using only the naked eye, or telescope of low magnifying power, — an opera-glass, for example, — was not more frequently put into practice, as it is susceptible of greater accuracy than can be reached in any other way.

The precise hour of observation not being mentioned in many of the accounts, it was necessary to supply it, sometimes from the context, but often from a consideration of the interval of visibility of the Comet at the date and place for which the deficiency was to be supplied; fortunately, this procedure was not exposed to much uncertainty, owing to the fact that, for the most part, the position of the Comet relatively to the Sun restricted the time of observation to the early hours of the evening.

From the end of August up to the 21st of September, the Comet preceded the Sun in right ascension, and was best seen in the morning. For a few days subsequent to the latter date, the morning and evening hours were nearly equally favorable. Comparatively few determinations of the figure and position of the tail are found in this interval, and for these the notices are, in general, sufficiently explicit as regards the time of observation.

After the 26th of September — in Europe generally after the 27th — the evening sky, for a short time while the Comet was still in a good position, was free

from both moonlight and twilight, and afforded an opportunity for viewing the tail to the best advantage. The Comet had now passed the Sun in right ascension, and had moved southward in declination, so as to be no longer visible in the morning.

It happens, fortunately, that nearly all the dates for which it is necessary to assume the time occur between the 25th of September and the middle of October, under circumstances which confine the possible times of observation within quite narrow limits, so that they can be supplied without incurring the risk of errors likely to be prejudicial.

So far as the evening observations are concerned, it will be evident that, during the greater part of the period in question, the end of twilight was the best moment for viewing the tail through its whole extent, as well as the earliest at which it was possible to distinguish the faint nebulosity at the upper extremity, the sky being then quite dark, and the effect of atmospheric extinction less than at any later hour. We shall adopt this as a probable limit in one direction; for the lower limit, failing other evidence, we may take the time when the head of the Comet reached the altitude of 7°. Below this point, owing to the extinction of its light in the Earth's atmosphere,* the outline was too much obscured for a good determination of its figure and position. It was noticed too, that, simultaneously with the reduction of the light of the lower part of the curve, as it neared the horizon, the extreme upper part became less and less distinct, until it quite disappeared, much sooner than would have been anticipated from the effect of atmospheric extinction merely, as if the eye needed the stimulus of the bright part, and the aid of the continuity of its curve, to enable it to keep the fainter parts in view. The choice of the particular altitude of 7° is of course somewhat arbitrary, but it is a question of no great importance whether we adopt this limit, or one a little higher or lower, since the uncertainty of a quarter or half an hour even would not have produced a very sensible change in the place of an object so ill-defined as the tail, excepting quite near to the nucleus. The omission of the time has not been so common with the drawings of the Comet as with the written descriptions; and even when it is wanting, the sketch still preserves the character of the curves, which we cannot suppose to have altered sensibly in the course of a single night, so that the precise time to which it corresponds is not indispensable.

* According to Seidel, (*Gelehrte Anzeigen*, XXXVII. No. 30,) at this height it must have had only *two sevenths* of its zenith brilliancy, and but *one half* of its brightness at 15° altitude.

In addition to these limits, namely, the end of twilight and the time of reaching the altitude of 7°, it has in most cases been found that the context of the passages quoted, without actually stating the time, still furnishes more or less evidence for determining the choice, and due regard has been given to such indications. The most common instance of this is when the notices of the appearance and position of the tail to the naked eye are associated with micrometric measurements or other telescopic observations upon the nucleus and envelope, for which the times are recorded. In such cases it may be presumed that the chronological order has been preserved in stating the observations. The notes upon the tail usually close each series, as they naturally would have done in point of time, since it must have been the common practice of astronomers to devote the early part of each evening to the details of the telescopic view of the head, while the sky was yet too bright for the tail to be seen.

These limits having been ascertained, if the choice of the time is otherwise unrestricted, we may adopt for the times of observation the expression

$$t = \tfrac{1}{2}\,(\text{latest limit} + \text{earliest limit}),$$

with the probable error

$$\eta = \pm\, \tfrac{1}{4}\,(\text{latest limit} - \text{earliest limit}).$$

The average value of η is considerably less than $\pm\, 0.020$ of a day, having reference merely to the particular circumstances now under consideration. Where the context indicates the time, without stating it explicitly, I have assumed for η the value $\pm\, 0^d.01$ or $\pm\, 0^d.00$, as circumstances may have dictated.

There may often be reasons for inclining to one or the other limit of t, for which no definite rule can be given; η, however, will, in such cases, always require to be diminished. The amount of the error in the position of a point in the tail corresponding to the value of η, may be estimated from the following numbers, showing the hourly advance of the front edge of the tail, in a direction normal to the curve.

Distance from the nucleus		2°	10°	18°
Sept. 16	Hourly motion	2′.4	. . .	. . .
28	"	5 .8	5′.4	5′.1
Oct. 10	"	11 .4	13 .3	13. 0

If these are compared with the probable errors of the observations, upon points similarly situated on the edge of the tail, it will appear that errors in t, which come within the limit of a quarter or even of half an hour, are not to be

regarded as serious in amount, excepting when the point is in the neighborhood of the nucleus.

The annexed tables have been used as a guide in fixing the limits supposed to include the times of observation.

1858.	Lat.	Sun sets.	Comet sets.	Comet at Alt. 7°.	End of Twilight.	Alt. of Comet at end of Twilight.
		m. s. t. h m	m. s. t. h m	m. s. t. h m	m. s. t. h m	° ′
Sept. 16	+40°	6 4	8 23	7 29	7 37	5 28
	50	6 7	10 0	8 30	8 0	9 44
	60	6 13	. . . .	11 46	8 46	13 16
22	40	5 53	8 26	7 37	7 25	8 8
	50	5 54	9 58	8 36	7 44	12 16
	60	5 55	. . . .	11 3	8 19	15 42
28	40	5 42	8 1	7 44	7 14	11 17
	50	5 39	9 40	8 31	7 29	14 30
	60	5 34	. . . .	10 2	7 59	16 40
Oct. 4	40	5 34	8 23	7 46	7 3	13 53
	50	5 27	8 58	8 12	7 15	14 59
	60	5 18	10 1	8 52	7 39	14 41
10	40	5 24	8 3	7 30	6 55	13 29
	50	5 14	8 6	7 29	7 3	10 32
	60	5 0	8 10	7 23	7 21	6 54
16	40	5 16	7 38	6 51	6 47	8 51
	50	5 3	7 12	6 25	6 52	3 6
	+60	4 43	6 29	5 20	7 4	. . . .

Mean Solar Times of End of Twilight.

1858.	+40°.	+42°.	+44°.	+46°.	+48°.	+50°.	+52°.	+54°.	+56°.	+58°.	+60°.
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 16	7 37	7 40	7 44	7 48	7 54	8 0	8 6	8 14	8 23	8 33	8 46
18	7 33	7 36	7 40	7 44	7 50	7 55	8 1	8 7	8 16	8 26	8 37
20	7 28	7 32	7 36	7 40	7 46	7 50	7 56	8 2	8 10	8 18	8 27
22	7 25	7 29	7 32	7 36	7 41	7 44	7 50	7 56	8 3	8 11	8 19
24	7 22	7 26	7 29	7 32	7 36	7 39	7 45	7 50	7 56	8 4	8 14
26	7 18	7 21	7 24	7 27	7 30	7 34	7 39	7 43	7 50	7 58	8 7
28	7 14	7 17	7 20	7 23	7 25	7 29	7 33	7 38	7 44	7 52	8 0
30	7 10	7 12	7 15	7 18	7 20	7 24	7 28	7 33	7 39	7 46	7 53
Oct. 2	7 7	7 9	7 11	7 14	7 17	7 20	7 24	7 28	7 33	7 39	7 46
4	7 3	7 5	7 7	7 9	7 12	7 15	7 19	7 23	7 28	7 34	7 39
6	7 0	7 1	7 3	7 5	7 7	7 10	7 14	7 18	7 22	7 27	7 32
8	6 57	6 58	7 0	7 2	7 4	7 6	7 10	7 14	7 18	7 22	7 27
10	6 55	6 56	6 57	6 59	7 1	7 3	7 5	7 9	7 13	7 17	7 21
12	6 51	6 52	6 53	6 55	6 56	6 58	7 0	7 3	7 8	7 11	7 15
14	6 49	6 50	6 50	6 51	6 52	6 54	6 56	6 58	7 2	7 5	7 9
16	6 46	6 47	6 47	6 49	6 50	6 51	6 53	6 55	6 58	7 1	7 4

The following table contains the numbers representing the relative amounts of moonlight during the more important part of the apparition of the Comet. Its effect upon the brightness and visible extent of the tail was most evident between the 15th and 27th of September, and subsequent to October 13th; in the interval between the last two dates the sky was mostly free from its influence, as the moon was either below the horizon, or gave but little light.

*Relative Intensity of Moonlight.**

1858.	Moon's Distances from Sun at Greenwich Midnight.	Moonlight.	1858.	Moon's Distances from Sun at Greenwich Midnight.	Moonlight.	1858.	Moon's Distances from Sun at Greenwich Midnight.	Moonlight.
Aug. 20	139° 17′ W.	0.58	Sept. 10	42° 29′ E.	0.01	Oct. 1	64° 45′ E.	0.04
21	150 13	0.72	11	54 10	0.02	2	51 42	0.03
22	161 13	0.87	12	65 32	0.04	3	38 47	0.01
23	172 33	0.93	13	76 39	0.06	4	26 1	0.00
24	169 0	0.91	14	87 36	0.13	5	13 25 E.	0.00
25	154 40	0.76	15	98 29	0.18	6	0 0	0.00
26	141 25	0.60	16	109 21	0.27	7	11 17 W.	0.00
27	139 5	0.48	17	120 19	0.36	8	23 14	0.00
28	126 34	0.44	18	131 25	0.47	9	34 48	0.01
29	113 53	0.28	19	142 46	0.60	10	46 4	0.01
30	101 1	0.20	20	154 37	0.77	11	57 7	0.03
31	87 58	0.13	21	167 28	0.90	12	68 2	0.04
Sept. 1	74 44	0.07	22	180 0	1.00	13	78 51	0.09
2	61 23	0.04	23	168 10	0.91	14	89 41	0.14
3	47 56	0.01	24	156 4	0.77	15	100 35	0.20
4	34 27	0.01	25	143 25	0.63	16	111 40	0.28
5	20 57	0.00	26	130 27	0.46	17	122 59	0.37
6	7 27 W.	0.00	27	117 21	0.33	18	134 36	0.51
7	4 58 E.	0.00	28	104 11	0.24	19	146 35	0.67
8	17 58	0.00	29	91 1	0.15	20	159 0 W.	0.85
9	30 28 E.	0.01	30	77 52 E.	0.07			

It will appear from the foregoing numbers that the most favorable positions for observations during the most interesting part of the apparition were north of the latitude $+50°$, including therefore the Observatories of Northern Europe.

The times adopted for dates requiring special attention are included in the following statement. They have been finally reduced to decimals of a day counted from 7^h m. s. t. at the Observatory of Harvard College. Their probable error is represented by η, having regard simply to the uncertainty attending the fixing of the time at which the observation was made, on the principles adopted in the foregoing remarks. The value $\eta = \pm\ 0^d.00$ indicates that the hour is either stated in the text, or may be inferred from it with certainty.

* Memoirs of the American Academy, Vol. VIII. p. 256.

Values of t used in reducing Observations upon the Tail.

1858. August 30. VIENNA. The earliest instance in which the direction of the tail has been referred to stars in its neighborhood occurs in the Vienna Observations of August 30, for which we find

$$t = 8^h\ 34^m - 5^h\ 50^m - 7^h\ 0^m = -\ 0^d.178 \quad \eta = \pm\ 0^d.00.$$

September 12. POULKOVA. WINNECKE.

$$t = 8^h\ 50^m - 6^h\ 46^m - 7^h\ 0^m = -\ 0^d.205 \quad \eta = \pm\ 0^d.02.$$

September 14. MARKREE.

$$t = 8^h\ 45^m - 4^h\ 11^m - 7^h\ 0^m = -\ 0^d.101 \quad \eta = \pm\ 0^d.02.$$

September 16. DORPAT.

$$t = 9^h\ 8^m - 6^h\ 31^m - 7^h\ 0^m = -\ 0^d.183 \quad \eta = \pm\ 0^d.01.$$

September 16. POULKOVA. For the chart we shall find from the position of the Comet among the stars in its neighborhood

$$t = +\ 0^d.040 \quad \eta = \pm\ 0^d.01$$

as the value of t which will best satisfy the place of the nucleus and the initial position of the axis derived from independent observations.

September 17. POULKOVA.

$$t = 14^h\ 29^m - 6^h\ 46^m - 7^h\ 0^m = +\ 0^d.030 \quad \eta = \pm\ 0^d.00.$$

September 17. OBSERVATORY OF HARVARD COLLEGE.

$$t = 7^h\ 30^m - 0^h\ 0^m - 7^h\ 0^m = +\ 0^d.021 \quad \eta = \pm\ 0^d.02.$$

September 18. POULKOVA. The position of the nucleus and initial axis on the chart correspond to the value

$$t = 0^d.030 \quad \eta = \pm\ 0^d.01.$$

September 19. POULKOVA. The position of the nucleus and initial axis on the chart, Tab. VI. Fig. 3, corresponds with the value

$$t = 0^d.000 \quad \eta = \pm\ 0^d.01.$$

As the Chart on Tab. I. does not afford any reliable determination of t, the same time has been assumed as for Tab. VI., viz.

$$t = 0^d.000 \quad \eta = \pm\ 0^d.05.$$

September 20. MARKREE.

$$t = 8^h\ 30^m - 4^h\ 11^m - 7^h\ 0^m = -\ 0^d.112 \quad \eta = \pm\ 0^d.02.$$

September 21. MARKREE.

$$t = 8^h\ 30^m - 4^h\ 11^m - 7^h\ 0^m = -\ 0^d.112 \quad \eta = \pm\ 0^d.02.$$

September 24. OBSERVATORY OF HARVARD COLLEGE.

$$t = 7^h\ 30^m - 0^h\ 0^m - 7^h\ 0^m = +\ 0^d.021 \quad \eta = \pm\ 0^d.02.$$

September 24. POULKOVA. For the measurements by O. Struve,

$$t = 7^h\ 32^m - 6^h\ 46^m - 7^h\ 0^m = -\ 0^d.260 \quad \eta = \pm\ 0^d.01.$$

September 26. OPORTO. For sketch,

$$t = 7^h\ 20^m - 4^h\ 10^m - 7^h\ 0^m = -\ 0^d.160 \quad \eta = \pm\ 0^d.00.$$

September 26. KINGSTON. C. W.

$$t = 7^h\ 40^m + 0^h\ 22^m - 7^h\ 0^m = -\ 0^d.043 \quad \eta = \pm\ 0^d.02.$$

September 26. POULKOVA. The positions having been taken from Harding's Chart, we have

for the right ascension of the Comet referred to the mean Equinox 1858.0,

$$\alpha \,☄ = 187° \; 38' + 42'.8 = 188° \; 20'.8,$$

corresponding to the $15^h \; 43^m$ m. s. t. at Poulkova, hence

$$t = 15^h \; 43^m - 6^h \; 46^m - 7^h \; 0^m = + 0^d.081 \quad \eta = \pm \; 0^d.01.$$

1858. September 27. OBSERVATORY OF HARVARD COLLEGE.

$$t = 7^h \; 15^m - 0^h \; 0^m - 7^h \; 0^m = + 0^d.010 \quad \eta = \pm \; 0^d.00.$$

$$t = 7^h \; 30^m - 0^h \; 0^m - 7^h \; 0^m = + 0^d.020 \quad \eta = \pm \; 0^d.02.$$

September 28. MARKREE.

$$t = 7^h \; 15^m - 4^h \; 11^m - 7^h \; 0^m = - 0^d.163 \quad \eta = \pm \; 0^d.00.$$

September 28. ALTONA. For the observed points,

$$t = 0^d.308 - 5^h \; 38^m - 7^h \; 0^m = - 0^d.216 \quad \eta = \pm \; 0^d.00.$$

$$t = 0^d.309 - 5^h \; 38^m - 7^h \; 0^m = - 0^d.217 \quad \eta = \pm \; 0^d.00.$$

For the lithographs,

$$t = 7^h \; 20^m - 5^h \; 24^m - 7^h \; 0^m = - 0^d.210 \quad \eta = \pm \; 0^d.00.$$

September 29. DORPAT. For the position of the tail at 9^h m. s. t.

$$t = 9^h \; 0^m - 6^h \; 31^m - 7^h \; 0^m = - 0^d.188 \quad \eta = \pm \; 0^d.00.$$

September 29. POULKOVA. WINNECKE. From the context it seems that the drawing was made some time subsequent to $19^h \; 45^m$ sid. time; the observations having been interrupted by clouds and renewed later in the night. The Comet was above the horizon through the night, but the moonlight, together with its low altitude, would have prevented satisfactory observations after 10^h m. s. t., when the Comet was already a little below the limit of 7° altitude. The value used has been

$$t = 9^h \; 0^m - 6^h \; 45^m - 7^h \; 0^m = - 0^d.198 \quad \eta = \pm \; 0^d.04.$$

September 29. VIENNA.

$$t = 7^h \; 40^m - 5^h \; 50^m - 7^h \; 0^m = - 0^d.215 \quad \eta = \pm \; 0^d.02.$$

September 30. OBSERVATORY OF HARVARD COLLEGE.

$$t = 7^h \; 30^m - 0^h \; 0^m - 7^h \; 0^m = + 0^d.021 \quad \eta = \pm \; 0^d.00.$$

September 30. CARBOST, ISLE OF SKYE.

$$t = 9^h \; 10^m - 4^h \; 19^m - 7^h \; 0^m = - 0^d.090 \quad \eta = \pm \; 0^d.00.$$

September 30. MARKREE.

$$t = 8^h \; 15^m - 4^h \; 11^m - 7^h \; 0^m = - 0^d.122 \quad \eta = \pm \; 0^d.01.$$

September 30. BRADSTONES, LIVERPOOL.

$$t = 8^h \; 0^m - 4^h \; 32^m - 7^h \; 0^m = - 0^d.147 \quad \eta = \pm \; 0^d.02.$$

September 30. POULKOVA. O. STRUVE. For the positions of the points on the margin of the tail, we have

$$t = 8^h \; 29^m - 6^h \; 46^m - 7^h \; 0^m = - 0^d.220 \quad \eta = \pm \; 0^d.00.$$

The value $t = -0.216$ satisfies the projected place of the nucleus and of the initial axis, and has been adopted.

September 30. POULKOVA. WINNECKE. For the observed points and for the lithographs,

$$t = 8^h \; 30^m - 6^h \; 45^m - 7^h \; 0^m = - 0^d.219 \quad \eta = \pm \; 0^d.02.$$

The value $t = - 0^d.251$ has been deduced from comparison of the projection of Winnecke's

places with those of O. Struve, and this value brings the front curves of the tail in the projections into good accordance: it has accordingly been adopted.

1858. October 1. COPENHAGEN.

$t = 7^h\ 30^m - 5^h\ 35^m - 7^h\ 0^m = -0^d.212 \quad \eta = \pm\ 0^d.02.$

October 1. OPORTO.

$t = 7^h\ 30^m - 4^h\ 10^m - 7^h\ 0^m = -0^d.153 \quad \eta = \pm\ 0^d.00.$

October 1. ALTONA. For the observed points,

$t = 0^d.350 - 5^h\ 38^m - 7^h\ 0^m = -0^d.176 \quad \eta = \pm\ 0^d.00.$

For the lithographs,

$t = 8^h\ 10^m - 5^h\ 24^m - 7^h\ 0^m = -0^d.176 \quad \eta = \pm\ 0^d.00.$

October 2. GREENWICH.

$t = 7^h\ 0^m - 4^h\ 44^m - 7^h\ 0^m = -0^d.197 \quad \eta = \pm\ 0^d.00.$

October 2. OBSERVATORY OF HARVARD COLLEGE.

$t = 7^h\ 15^m - 0^h\ 0^m - 7^h\ 0^m = +0^d.010 \quad \eta = \pm\ 0^d.00.$

$t = 8^h\ 0^m - 0^h\ 0^m - 7^h\ 0^m = +0^d.042 \quad \eta = \pm\ 0^d.00.$

October 2. VIENNA.

$t = 7^h\ 23^m - 5^h\ 50^m - 7^h\ 0^m = -0^d.227 \quad \eta = \pm\ 0^d.00.$

October 2. DORPAT.

$t = 8^h\ 45^m - 6^h\ 31^m - 7^h\ 0^m = -0^d.199 \quad \eta = \pm\ 0^d.01.$

October 2. ALTONA.

$t = 0^d.301 - 5^h\ 38^m - 7^h\ 0^m = -0^d.225 \quad \eta = \pm\ 0^d.00.$

October 2. ALBANY.

$t = 0^d.310 + 0^h\ 24^m - 7^h\ 0^m = +0^d.035 \quad \eta = \pm\ 0^d.00.$

October 3. GREENWICH.

$t = 7^h\ 45^m - 4^h\ 44^m - 7^h\ 0^m = -0^d.166 \quad \eta = \pm\ 0^d.01.$

October 3. BRESLAU.

$t = 8^h\ 0^m - 5^h\ 53^m - 7^h\ 0^m = -0^d.203 \quad \eta = \pm\ 0^d.00.$

October 3. MEADVILLE.

$t = 7^h\ 0^m + 0^h\ 37^m - 7^h\ 0^m = +0^d.026 \quad \eta = \pm\ 0^d.00.$

October 3. VIENNA.

$t = 7^h\ 59^m - 5^h\ 50^m - 7^h\ 0^m = -0^d.202 \quad \eta = \pm\ 0^d.00.$

October 4. OBSERVATORY OF HARVARD COLLEGE.

$t = 8^h\ 0^m - 0^h\ 0^m - 7^h\ 0^m = +0^d.042 \quad \eta = \pm\ 0^d.01.$

October 4. MARKREE.

$t = 10^h\ 0^m - 4^h\ 11^m - 7^h\ 0^m = -0^d.049 \quad \eta = \pm\ 0^d.00.$

October 4. OPORTO.

$t = 7^h\ 4^m - 4^h\ 10^m - 7^h\ 0^m = -0^d.171 \quad \eta = \pm\ 0^d.00.$

October 4. BRESLAU.

$t = 7^h\ 30^m - 5^h\ 53^m - 7^h\ 0^m = -0^d.224 \quad \eta = \pm\ 0^d.02.$

October 4. MÜNSTER.

$t = 7^h\ 30^m - 5^h\ 5^m - 7^h\ 0^m = -0^d.191 \quad \eta = \pm\ 0^d.02.$

1858. October 4. VIENNA. For the description,

$t = 8^h\ 0^m - 5^h\ 50^m - 7^h\ 0^m = -\ 0^d.200 \quad \eta = \pm\ 0^d.02.$

For observed points,

$t = 8^h\ 15^m - 6^h\ 31^m - 7^h\ 0^m = -\ 0^d.190 \quad \eta = \pm\ 0^d.00.$

October 4. DORPAT.

$t = 9^h\ 50^m - 6^h\ 31^m - 7^h\ 0^m = -\ 0^d.153 \quad \eta = \pm\ 0^d.01.$

October 4. ALTONA.

$t = 0^d.347 - 5^h\ 38^m - 7^h\ 0^m = -\ 0^d.179 \quad \eta = \pm\ 0^d.00.$

October 4. COLLEGIO ROMANO.

$t = 7^h\ 0^m - 5^h\ 34^m - 7^h\ 0^m = -\ 0^d.232 \quad \eta = \pm\ 0^d.01.$

October 4. POULKOVA.

$t = 14^h\ 0^m - 6^h\ 46^m - 7^h\ 0^m = +\ 0^d.010 \quad \eta = \pm\ 0^d.00.$

October 5. WORCESTER.

$t = 8^h\ 0^m + 0^h\ 3^m - 7^h\ 0^m = +\ 0^d.044 \quad \eta = \pm\ 0^d.01.$

October 5. OBSERVATORY OF HARVARD COLLEGE.

$t = 8^h\ 15^m - 0^h\ 0^m - 7^h\ 0^m = +\ 0^d.052 \quad \eta = \pm\ 0^d.01.$

October 5. HADDENHAM. For the position of the tail referred to θ, ι, and $\varkappa$ Boötis,

$t = 8^h\ 0^m - 4^h\ 43^m - 7^h\ 0^m = -\ 0^d.155 \quad \eta = \pm\ 0^d.01.$

October 5. OPORTO.

$t = 6^h\ 40^m - 4^h\ 10^m - 7^h\ 0^m = -\ 0^d.187 \quad \eta = \pm\ 0^d.00.$

October 5. CRANFORD.

$t = 8^h\ 0^m - 4^h\ 44^m - 7^h\ 0^m = -\ 0^d.156 \quad \eta = \pm\ 0^d.00.$

October 5. BRESLAU.

$t = 7^h\ 30^m - 5^h\ 53^m - 7^h\ 0^m = -\ 0^d.224 \quad \eta = \pm\ 0^d.01.$

October 5. MÜNSTER.

$t = 7^h\ 30^m - 5^h\ 5^m - 7^h\ 0^m = -\ 0^d.191 \quad \eta = \pm\ 0^d.01.$

October 5. VIENNA.

$t = 8^h\ 0^m - 5^h\ 50^m - 7^h\ 0^m = -\ 0^d.201 \quad \eta = \pm\ 0^d.02.$

October 5. DORPAT. LAIS.

$t = 9^h\ 30^m - 6^h\ 31^m - 7^h\ 0^m = -\ 0^d.167 \quad \eta = \pm\ 0^d.00.$

October 5. DORPAT. MÄDLER.

$t = 7^h\ 30^m - 6^h\ 31^m - 7^h\ 0^m = -\ 0^d.251 \quad \eta = \pm\ 0^d.02.$

October 5. ALTONA. For the lithographs,

$t = 7^h\ 50^m - 5^h\ 24^m - 7^h\ 0^m = -\ 0^d.190 \quad \eta = \pm\ 0^d.00.$

For the observed points in the tail,

$t = 0^d.333 - 5^h\ 38^m - 7^h\ 0^m = +\ 0^d.207 \quad \eta = \pm\ 0^d.00.$

October 5. GENEVA.

$t = 7^h\ 10^m - 5^h\ 9^m - 7^h\ 0^m = -\ 0^d.208 \quad \eta = \pm\ 0^d.01.$

October 5. ALBANY.

$t = 0^d.310 + 0^h\ 24^m - 7^h\ 0^m = +\ 0^d.033 \quad \eta = \pm\ 0^d.00.$

October 5. OXFORD.

$t = 7^h\ 0^m - 4^h\ 39^m - 7^h\ 0^m = -\ 0^d.194 \quad \eta = \pm\ 0^d.01.$

October 5. POULKOVA.

$t = 7^h\ 20^m - 6^h\ 46^m - 7^h\ 0^m = -\ 0^d.268 \quad \eta = \pm\ 0^d.01.$

1858. October 5. Tretire.

$t = 7^h\ 40^m - 4^h\ 34^m - 7^h\ 0^m = -\ 0^d.162 \quad \eta = \pm\ 0^d.02.$

October 6. Observatory of Harvard College.

$t = 7^h\ 40^m - 0^h\ 0^m - 7^h\ 0^m = +\ 0^d.028 \quad \eta = \pm\ 0^d.01.$

October 6. Breslau.

$t = 7^h\ 30^m - 5^h\ 53^m - 7^h\ 0^m = -\ 0^d.224 \quad \eta = \pm\ 0^d.02.$

October 6. Münster. For the Chart,

$t = 7^h\ 30^m - 5^h\ 5^m - 7^h\ 0^m = -\ 0^d.191 \quad \eta = \pm\ 0^d.00.$

October 6. Neuchatel.

$t = 8^h\ 0^m - 5^h\ 12^m - 7^h\ 0^m = -\ 0^d.175 \quad \eta = \pm\ 0^d.01.$

October 6. Dorpat.

$t = 8^h\ 15^m - 6^h\ 31^m - 7^h\ 0^m = -\ 0^d.219 \quad \eta = \pm\ 0^d.01.$

October 6. Altona.

$t = 0^d.326 - 5^h\ 38^m - 7^h\ 0^m = -\ 0^d.200 \quad \eta = \pm\ 0^d.00.$

October 6. Vienna.

$t = 7^h\ 30^m - 5^h\ 50^m - 7^h\ 0^m = -\ 0^d.222 \quad \eta = \pm\ 0^d.02.$

October 7. Markree.

$t = 7^h\ 30^m - 4^h\ 11^m - 7^h\ 0^m = -\ 0^d.153 \quad \eta = \pm\ 0^d.02.$

October 7. Münster.

$t = 7^h\ 30^m - 5^h\ 5^m - 7^h\ 0^m = -\ 0^d.191 \quad \eta = \pm\ 0^d.02.$

October 7. Vienna. For the description,

$t = 7^h\ 40^m - 5^h\ 50^m - 7^h\ 0^m = -\ 0^d.215 \quad \eta = \pm\ 0^d.02.$

For the observed points in the tail,

$t = 8^h\ 15^m - 5^h\ 50^m - 7^h\ 0^m = -\ 0^d.191 \quad \eta = \pm\ 0^d.00.$

October 7. Dorpat.

$t = 7^h\ 45^m - 6^h\ 31^m - 7^h\ 0^m = -\ 0^d.240 \quad \eta = \pm\ 0^d.02.$

October 7. Poulkova. O. Struve.

$t = 7^h\ 45^m - 6^h\ 46^m - 7^h\ 0^m = -\ 0^d.299 \quad \eta = \pm\ 0^d.02.$

October 7. Poulkova. Winnecke.

$t = 7^h\ 10^m - 6^h\ 46^m - 7^h\ 0^m = -\ 0^d.275 \quad \eta = \pm\ 0^d.00.$

October 8. Markree. For the descriptions and Chart,

$t = 8^h\ 0^m - 4^h\ 11^m - 7^h\ 0^m = -\ 0^d.133 \quad \eta = \pm\ 0^d.00.$

October 8. Observatory of Harvard College. For the Chart,

$t = 7^h\ 30^m - 0^h\ 0^m - 7^h\ 0^m = +\ 0^d.021 \quad \eta = \pm\ 0^d.01.$

October 8. Breslau.

$t = 6^h\ 45^m - 5^h\ 53^m - 7^h\ 0^m = -\ 0^d.256 \quad \eta = \pm\ 0^d.01.$

October 8. Münster.

$t = 7^h\ 30^m - 5^h\ 5^m - 7^h\ 0^m = -\ 0^d.191 \quad \eta = \pm\ 0^d.00.$

October 8. Altona. For the observed points in the tail,

$t = 0^d.319 - 5^h\ 38^m - 7^h\ 0^m = -\ 0^d.207 \quad \eta = \pm\ 0^d.00.$

October 8. Albany.

$t = 0^d.275 + 0^h\ 24^m - 7^h\ 0^m = \ 0^d.000 \quad \eta = \pm\ 0^d.01.$

October 8. Collegio Romano. For the Chart,

$t = 7^h\ 30^m - 5^h\ 34^m - 7^h\ 0^m = -\ 0^d.211 \quad \eta = \pm\ 0^d.01.$

1858. October 8. TRETIRE.

$t = 7^h\ 30^m - 4^h\ 34^m - 7^h\ 0^m = -\ 0^d.166 \quad \eta = \pm\ 0^d.01.$

October 8. POULKOVA.

$t = 7^h\ 15^m - 6^h\ 46^m - 7^h\ 0^m = -\ 0^d.272 \quad \eta = \pm\ 0^d.01.$

October 8. VIENNA.

$t = 7^h\ 15^m - 5^h\ 50^m - 7^h\ 0^m = -\ 0^d.233 \quad \eta = \pm\ 0^d.01.$

October 9. OPORTO.

$t = 7^h\ 15^m - 4^h\ 10^m - 7^h\ 0^m = -\ 0^d.126 \quad \eta = \pm\ 0^d.00.$

October 9. MÜNSTER.

$t = 7^h\ 0^m - 5^h\ 5^m - 7^h\ 0^m = -\ 0^d.212 \quad \eta = \pm\ 0^d.00.$

October 9. DORPAT.

$t = 7^h\ 0^m - 6^h\ 31^m - 7^h\ 0^m = -\ 0^d.272 \quad \eta = \pm\ 0^d.01.$

October 9. ALTONA. For the Chart,

$t = 6^h\ 45^m - 5^h\ 24^m - 7^h\ 0^m = -\ 0^d.235 \quad \eta = \pm\ 0^d.00.$

For the positions of points in the tail,

$t = 0^d.288 - 5^h\ 38^m - 7^h\ 0^m = -\ 0^d.238 \quad \eta = \pm\ 0^d.00.$

October 9. ALBANY.

$t = 0^d.333 + 0^h\ 24^m - 7^h\ 0^m = +\ 0^d.058 \quad \eta = \pm\ 0^d.00.$

October 9. POULKOVA. For the lithographs,

$t = 7^h\ 28^m - 6^h\ 46^m - 7^h\ 0^m = -\ 0^d.262 \quad \eta = \pm\ 0^d.00.$

October 9. HUNT'S CORNERS.

$t = 7^h\ 20^m + 0^h\ 24^m - 7^h\ 0^m = +\ 0^d.031 \quad \eta = \pm\ 0^d.01.$

October 9. POULKOVA. WINNECKE.

$t = 7^h\ 30^m - 6^h\ 46^m - 7^h\ 0^m = -\ 0^d.261 \quad \eta = \pm\ 0^d.01.$

October 10. OPORTO.

$t = 7^h\ 15^m - 4^h\ 10^m - 7^h\ 0^m = -\ 0^d.163 \quad \eta = \pm\ 0^d.00.$

October 10. MÜNSTER.

$t = 7^h\ 0^m - 5^h\ 5^m - 7^h\ 0^m = -\ 0^d.212 \quad \eta = \pm\ 0^d.00.$

October 10. ALTONA.

$t = 0^d.319 - 5^h\ 38^m - 7^h\ 0^m = -\ 0^d.207 \quad \eta = \pm\ 0^d.00.$

October 10. ALBANY.

$t = 0^d.290 + 0^h\ 24^m - 7^h\ 0^m = +\ 0^d.017 \quad \eta = \pm\ 0^d.00.$

October 10. MUSSOREE.

$t = 7^h\ 10^m - 9^h\ 57^m - 7^h\ 0^m = -\ 0^d.408 \quad \eta = \pm\ 0^d.01.$

October 10. TRETIRE.

$t = 7^h\ 15^m - 4^h\ 34^m - 7^h\ 0^m = -\ 0^d.180 \quad \eta = \pm\ 0^d.01.$

October 11. MÜNSTER.

$t = 7^h\ 0^m - 5^h\ 5^m - 7^h\ 0^m = -\ 0^d.212 \quad \eta = \pm\ 0^d.00.$

October 11. VIENNA.

$t = 7^h\ 15^m - 5^h\ 50^m - 7^h\ 0^m = -\ 0^d.233 \quad \eta = \pm\ 0^d.01.$

October 11. TRETIRE.

$t = 7^h\ 15^m - 4^h\ 30^m - 7^h\ 0^m = -\ 0^d.177 \quad \eta = \pm\ 0^d.01.$

October 12. OPORTO.

$t = 7^h\ 0^m - 4^h\ 10^m - 7^h\ 0^m = -\ 0^d.174 \quad \eta = \pm\ 0^d.00.$

1858. October 12. MÜNSTER.

[$t = 7^h\ 0^m - 5^h\ 5^m - 7^h\ 0^m = -\ 0^d.212.$]

The position of the tail near the nucleus evidently indicates a much smaller value, $t = -\ 0^d.093$; the mean between them, $t = -\ 0^d.153$ $\eta = \pm\ 0^d.04$, has been adopted, although this is after the head of the Comet had set.

October 12. DORPAT.

$t = 7^h\ 15^m - 6^h\ 31^m - 7^h\ 0^m = -\ 0^d.261 \quad \eta = \pm\ 0^d.01.$

October 12. ALTONA.

$t = 0^d.308 - 5^h\ 38^m - 7^h\ 0^m = -\ 0^d.216 \quad \eta = \pm\ 0^d.00.$

For the lithograph,

$t = 7^h\ 0^m - 5^h\ 24^m - 7^h\ 0^m = -\ 0^d.225 \quad \eta = \pm\ 0^d.00.$

October 12. OBSERVATORY OF HARVARD COLLEGE.

$t = 8^h\ 10^m - 0^h\ 0^m - 7^h\ 0^m = +\ 0^d.034 \quad \eta = \pm\ 0^d.01.$

October 13. OPORTO.

$t = 6^h\ 55^m - 4^h\ 10^m - 7^h\ 0^m = -\ 0^d.177 \quad \eta = \pm\ 0^d.00.$

October 13. GENEVA.

$t = 7^h\ 0^m - 5^h\ 9^m - 7^h\ 0^m = -\ 0^d.215 \quad \eta = \pm\ 0^d.01.$

October 13. POULKOVA.

$t = 7^h\ 0^m - 6^h\ 46^m - 7^h\ 0^m = -\ 0^d.282 \quad \eta = \pm\ 0^d.01.$

October 14. OPORTO.

$t = 7^h\ 5^m - 4^h\ 10^m - 7^h\ 0^m = -\ 0^d.170 \quad \eta = \pm\ 0^d.00.$

October 14. DORPAT.

$t = 6^h\ 45^m - 6^h\ 31^m - 7^h\ 0^m = -\ 0^d.282 \quad \eta = \pm\ 0^d.01.$

October 15. OPORTO.

$t = 7^h\ 0^m - 4^h\ 10^m - 7^h\ 0^m = -\ 0^d.174 \quad \eta = \pm\ 0^d.00.$

October 15. BRESLAU.

$t = 6^h\ 45^m - 5^h\ 53^m - 7^h\ 0^m = -\ 0^d.256 \quad \eta = \pm\ 0^d.01.$

October 15. ALBANY.

$t = 0^d.290 + 0^h\ 24^m - 7^h\ 0^m = +\ 0^d.018 \quad \eta = \pm\ 0^d.00.$

October 16. BRESLAU.

$t = 6^h\ 45^m - 5^h\ 53^m - 7^h\ 0^m = -\ 0^d.256 \quad \eta = \pm\ 0^d.01.$

October 17. MELBOURNE.

$t = -\ 0^d.483$ . . . . $\eta = \pm\ 0^d.02.$

October 24. MELBOURNE.

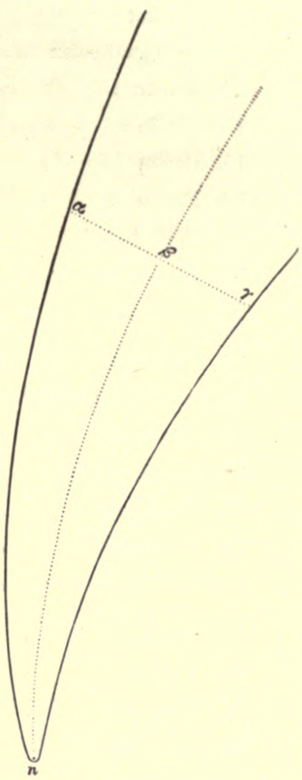
$t = -\ 0^d.572$ . . . . $\eta = \pm\ 0^d.02.$

With these values of t, all the observations have been reduced to the epoch $t = 0^d.000$, by carrying forward each observed point through an arc equal to the motion of the tail during the interval t, and in a direction parallel to the motion of the nucleus as projected on the chart.* The daily motion of the tail has been

* Straight lines on the chart represent, strictly speaking, arcs of loxodromic curves, but they sensibly coincide with projections of arcs of great circles for limited distances, like those here considered.

derived from the provisional chart. In applying it, account has been taken of second differences.

Fig. 12.



In order to refer the observations upon the axis and rear edge to the front edge, the breadth of the tail at different distances from the nucleus has been investigated in the following manner.

In the annexed diagram, Fig. 12, let α and γ represent points in the front and rear outlines of the tail, as projected upon the charts, and n the nucleus; and let a straight line be drawn, making equal angles at α and γ with the tangents to the two curves at these points. The point β, taken midway between them, is supposed to lie in the axis of the tail. Its breadth, at the distance $n\beta = a$ measured on a straight line from the nucleus, is represented by $\alpha\gamma = b$.

A collection of the lengths of the tail, and of its breadth at various distances from the head, is here subjoined. Its breadth at distances less than 0° 10′ will be ascertained from telescopic observations and figures, by a separate discussion.

Length and Breadth of the Tail.

1858.				°	′
Aug.	14.	Vienna	Length of Tail	0	10
	24.	Copenhagen	"	0	6
	29.	Obs. Harv. Coll.	"	2	0
	30.	Vienna	"	1	0
	30.	Kremsmünster	"	0	30
	30.	Vienna	$a = 1^\circ\ 0$ $b =$	0	10
Sept.	1.	Kremsmünster	Length of Tail	0	30
	2.	Copenhagen	"	1	45
	2.	Kremsmünster	"	0	45
	3.	Florence	"	2	0
	4.	Poulkova	"	1	2
	5.	Vienna	"	2	0
	5.	Vienna	$a = 2^\circ\ 0'$ $b =$	0	30

1858.				°	′
Sept.	8.	Obs. Harv. Coll.	Length of Tail	4	0
	8.	Obs. Harv. Coll.	"	2	0
	8.	Highbury	"	0	30
	10.	Vienna	"	5	24
	10.	Vienna	"	4	0
	10.	Münster	"	3	0
	10.	Kremsmünster	"	2	0
	10.	Vienna	$a = 1^\circ\ 0'$ $b =$	0	15
	10.	Vienna	$a = 0\ 30$ $b =$	0	15
	12.	Obs. Harv. Coll.	Length of Tail	6	0
	12.	Obs. Harv. Coll.	"	5	30
	12.	Regent's Park	"	5	0
	12.	Obs. Harv. Coll.	"	4	0

Sept. 12.	Haddenham	Length of Tail	3° 30′
12.	Highbury	"	3 0
12.	Poulkova	"	2 30
13.	Vienna	"	6 0
13.	Kremsmünster	"	2 20
14.	Markree	"	5 0
15.	Berlin	"	6 0
15.	Berlin	"	5 0
16.	Berlin	"	7 0
16.	Dorpat	"	7 0
16.	Kremsmünster	"	4 0
16.	Poulkova	"	4 0
16.	Poulkova	$a = 4° 0′$	$b = 0\ 30$
16.	Obs. Harv. Coll.	$a = 3\ 0$	$b = 0\ 20$
16.	Poulkova	$a = 2\ 0$	$b = 0\ 22$
16.	Poulkova	$a = 1\ 0$	$b = 0\ 18$
16.	Poulkova	$a = 0\ 30$	$b = 0\ 15$
16.	Poulkova	$a = 0\ 26$	$b = 0\ 14$
16.	Poulkova	$a = 0\ 13$	$b = 0\ 9.5$
17.	Poulkova	Length of Tail	8 0
17.	Vienna	"	6 0
17.	Kingston, C. W.	"	5 0
17.	Obs. Harv. Coll.	"	4 0
18.	Poulkova	"	5 0
18.	Poulkova	$a = 4° 0′$	$b = 0\ 40$
18.	Poulkova	$a = 2\ 0$	$b = 0\ 33$
18.	Poulkova	$a = 1\ 0$	$b = 0\ 25$
18.	Poulkova	$a = 0\ 30$	$b = 0\ 20$
19.	Poulkova	Length of Tail	8 0
19.	Poulkova	$a = 8° 0′$	$b = 1\ 25$
19.	Poulkova	$a = 4\ 0$	$b = 0\ 35$
19.	Poulkova	$a = 2\ 0$	$b = 0\ 32$
19.	Poulkova	$a = 1\ 0$	$b = 0\ 24$
19.	Poulkova	$a = 0\ 30$	$b = 0\ 17$
20.	Markree	Length of Tail	6 0
20.	Altona	"	4 0
21.	Highbury	"	8 0
21.	Cambridge, Eng.	"	5 0
22.	Vienna	"	5 0
22.	Münster	"	3 0

Sept. 23.	Dorpat	Length of Tail	10° 0′
23.	Obs. Harv. Coll.	"	7 0
24.	Kingston, C. W.	"	8 0
24.	Obs. Harv. Coll.	"	7 0
25.	Obs. Harv. Coll.	"	10 30
25.	Berlin	"	10 0
25.	Kremsmünster	"	10 0
25.	Berlin	"	9 0
25.	Sacramento	"	8 30
25.	Obs. Harv. Coll.	$a = 10° 30′$	$b = 1\ 0$
25.	Poulkova	$a = 0\ 26$	$b = 0\ 11.7$
25.	Obs. Harv. Coll.	$a = 0\ 12$	$b = 0\ 5.5$
26.	Sacramento	Length of Tail	10 30
26.	Kingston, C. W.	"	10 0
26.	Havana	"	10 0
26.	Vienna	"	9 48
26.	Copenhagen	"	7 0
26.	Oporto	$a = 7° 0′$	$b = 0\ 55$
26.	Poulkova	$a = 6\ 0$	$b = 0\ 46$
26.	Poulkova	$a = 5\ 0$	$b = 0\ 41$
26.	Poulkova	$a = 4\ 0$	$b = 0\ 36$
26.	Poulkova	$a = 3\ 0$	$b = 0\ 30$
26.	Poulkova	$a = 2\ 0$	$b = 0\ 23$
26.	Poulkova	$a = 1\ 0$	$b = 0\ 17$
26.	Poulkova	$a = 0\ 30$	$b = 0\ 13$
27.	Obs. Harv. Coll.	Length of Tail	14 15
27.	Kremsmünster	"	14 0
27.	Neuchatel	"	11 0
27.	Obs. Harv. Coll.	"	9 30
27.	Cambridge, Eng.	"	7 30
27.	Obs. Harv. Coll.	$a = 13° 0′$	$b = 1\ 30$
27.	Obs. Harv. Coll.	$a = 12\ 0$	$b = 2\ 0$
27.	Obs. Harv. Coll.	$a = 12\ 0$	$b = 2\ 45$
27.	Obs. Harv. Coll.	$a = 6\ 0$	$b = 0\ 40$
27.	Poulkova	$a = 0\ 53$	$b = 0\ 13.5$
27.	Poulkova	$a = 0\ 26$	$b = 0\ 11$
28.	Obs. Harv. Coll.	Length of Tail	19 0
28.	Geneva	"	18 30
28.	Copenhagen	"	13 0
28.	Altona	$a = 16° 0′$	$b = 2\ 2$

Sept. 28.	Kremsmünster	a = 16° 0′	b = 1° 0′
28.	Markree	a = 15 0	b = 2 20
28.	Vienna	a = 14 0	b = 2 18
28.	Markree	a = 6 50	b = 2 10
28.	Altona	a = 6 50	b = 1 25
28.	Obs. Harv. Coll.	a = 4 0	b = 1 1
28.	Altona	a = 4 0	b = 1 8
28.	Altona	a = 1 0	b = 0 30
29.	Vienna	Length of Tail	22 30
29.	Kremsmünster	"	20 0
29.	Göttingen	"	19 0
29.	Münster	"	16 0
29.	Havana	"	15 0
29.	Poulkova	a = 6° 0′	b = 0 52
29.	Poulkova	a = 5 0	b = 0 47
29.	Poulkova	a = 4 0	b = 0 40
29.	Poulkova	a = 3 0	b = 0 36
29.	Poulkova	a = 2 0	b = 0 31
29.	Poulkova	a = 1 0	b = 0 23
30.	Poulkova	Length of Tail	35 0
30.	Liverpool	"	26 0
30.	Florence	"	25 0
30.	Poulkova	"	25 0
30.	Greenwich	"	22 30
30.	Obs. Harv. Coll.	"	22 30
30.	Vienna	"	22 0
30.	Cambridge, Eng.	"	20 0
30.	Markree	"	19 0
30.	Poulkova	"	19 0
30.	Liverpool	a = 26° 0′	b = 3 10
30.	Poulkova	a = 25 0	b = 4 0
30.	Obs. Harv. Coll.	a = 22 30	b = 2 30
30.	Obs. Harv. Coll.	a = 19 30	b = 2 0
30.	Poulkova	a = 8 0	b = 1 26
30.	Poulkova	a = 8 0	b = 1 22
30.	Poulkova	a = 7 0	b = 1 17
30.	Poulkova	a = 6 0	b = 1 9
30.	Poulkova	a = 6 0	b = 1 12
30.	Poulkova	a = 5 0	b = 1 4
30.	Poulkova	a = 5 0	b = 1 4
30.	Poulkova	a = 4 0	b = 0 58
30.	Poulkova	a = 4 0	b = 0 52

Sept. 30.	Poulkova	a = 3° 0′	b = 0° 51′
30.	Poulkova	a = 3 0	b = 0 43
30.	Poulkova	a = 2 0	b = 0 39
30.	Poulkova	a = 1 0	b = 0 25
30.	Poulkova	a = 0 30	b = 0 16.6
30.	Poulkova	a = 0 26	b = 0 14.5
Oct. 1.	Florence	Length of Tail	27 0
1.	Kremsmünster	"	25 0
1.	Göttingen	"	23 0
1.	Highbury	"	21 0
1.	Copenhagen	"	20 0
1.	Berlin	"	18 0
1.	Göttingen	a = 23° 0′	b = 4 0
1.	Copenhagen	a = 20 0	b = 9 0
1.	Oporto	a = 16 0	b = 2 35
1.	Altona	a = 16 0	b = 4 18
1.	Altona	a = 13 0	b = 2 45
1.	Altona	a = 12 0	b = 3 33
1.	Altona	a = 10 0	b = 3 6
1.	Altona	a = 8 0	b = 2 33
1.	Altona	a = 6 0	b = 2 0
1.	Altona	a = 4 0	b = 1 14
1.	Altona	a = 3 0	b = 0 55
1.	Altona	a = 1 0	b = 0 36
2.	Cambridge, Eng.	Length of Tail	33 0
2.	Obs. Harv. Coll.	"	29 0
2.	Albany	"	26 0
2.	Greenwich	"	25 0
2.	Albany	"	24 0
2.	Dorpat	"	24 0
2.	Dorpat	"	23 30
2.	Obs. Harv. Coll.	"	23 0
2.	Kingston, C. W.	"	20 0
2.	Madras	"	(16 0)
2.	Obs. Harv. Coll.	a = 29° 0′	b = 5 0
2.	Albany	a = 26 0	b = 4 0
2.	Albany	a = 24 0	b = 5 0
2.	Obs. Harv. Coll.	a = 23 0	b = 4 0
2.	Obs. Harv. Coll.	a = 20 0	b = 4 45
2.	Obs. Harv. Coll.	a = 20 0	b = 4 40
2.	Altona	a = 13 0	b = 3 5

Oct. 2.	Obs. Harv. Coll.	$a = 13^\circ\ 0'$	$b = 2^\circ\ 30'$
2.	Obs. Harv. Coll.	$a = 12\ 0$	$b = 3\ 15$
2.	Obs. Harv. Coll.	$a = 12\ 0$	$b = 3\ 10$
2.	Obs. Harv. Coll.	$a = 12\ 0$	$b = 3\ 20$
2.	Obs. Harv. Coll.	$a = 4\ 0$	$b = 1\ 15$
2.	Obs. Harv. Coll.	$a = 4\ 0$	$b = 1\ 20$
2.	Vienna	$a = 1\ 3$	$b = 0\ 17.9$
2.	Vienna	$a = 0\ 35$	$b = 0\ 15.9$
3.	Kremsmünster	Length of Tail	30 0
3.	Vienna	"	30 0
3.	Göttingen	"	26 0
3.	Vienna	"	25 30
3.	Münster	"	25 0
3.	Madras	"	25 0
3.	Vienna	$a = 30^\circ\ 0'$	$b = 3\ 0$
3.	Meadville	$a = 20\ 0$	$b = 2\ 20$
3.	Meadville	$a = 12\ 0$	$b = 2\ 0$
3.	Meadville	$a = 4\ 0$	$b = 1\ 0$
3.	Vienna	$a = 2\ 36$	$b = 0\ 39.5$
3.	Vienna	$a = 2\ 2$	$b = 0\ 36.5$
3.	Vienna	$a = 1\ 28$	$b = 0\ 25.9$
3.	Vienna	$a = 0\ 58$	$b = 0\ 19.0$
3.	Vienna	$a = 0\ 36$	$b = 0\ 15.2$
3.	Vienna	$a = 0\ 16$	$b = 0\ 10.8$
4.	Poulkova	Length of Tail	35 0
4.	Kremsmünster	"	35 0
4.	Obs. Harv. Coll.	"	35 0
4.	Liverpool	"	31 30
4.	Markree	"	30 0
4.	Vienna	"	30 0
4.	Dorpat	"	30 0
4.	Göttingen	"	28 0
4.	Madras	"	(24 0)
4.	Oporto	"	22 0
4.	Berlin	"	(20 0)
4.	Kremsmünster	$a = 35^\circ\ 0'$	$b = 6\ 0$
4.	Liverpool	$a = 31\ 30$	$b = 6\ 0$
4.	Münster	$a = 30\ 0$	$b = 10\ 0$
4.	Breslau	$a = 21\ 0$	$b = 4\ 0$
4.	Oporto	$a = 20\ 0$	$b = 2\ 54$
4.	Altona	$a = 19\ 0$	$b = 7\ 0$

Oct. 4.	Oporto	$a = 16^\circ\ 0'$	$b = 2^\circ\ 40'$
4.	Oporto	$a = 12\ 0$	$b = 2\ 10$
4.	Oporto	$a = 8\ 0$	$b = 1\ 48$
4.	Oporto	$a = 4\ 0$	$b = 1\ 25$
4.	Vienna	$a = 1\ 56$	$b = 0\ 35.7$
4.	Vienna	$a = 1\ 20$	$b = 0\ 26.3$
4.	Vienna	$a = 0\ 43$	$b = 0\ 18.4$
4.	Vienna	$a = 0\ 26$	$b = 0\ 14.0$
5.	Dorpat	Length of Tail	45 0
5.	Geneva	"	40 0
5.	Florence	"	40 0
5.	Obs. Harv. Coll.	"	38 0
5.	Vienna	"	37 0
5.	Dorpat	"	36 0
5.	Cranford	"	36 0
5.	Obs. Harv. Coll.	"	35 0
5.	Poulkova	"	34 0
5.	Poulkova	"	34 0
5.	Münster	"	33 0
5.	Vienna	"	32 30
5.	Haddenham	"	32 30
5.	Kingston, C. W.	"	32 0
5.	Aylesbury	"	30 0
5.	Copenhagen	"	30 0
5.	Highbury	"	28 0
5.	Albany	"	27 0
5.	Albany	"	22 0
5.	Breslau	"	(20 0)
5.	Vienna	$a = 37^\circ\ 0'$	$b = 5\ 0$
5.	Poulkova	$a = 34\ 0$	$b = 4\ 20$
5.	Aylesbury	$a = 30\ 0$	$b = 6\ 30$
5.	Obs. Harv. Coll.	$a = 30\ 0$	$b = 5\ 30$
5.	Münster	$a = 28\ 0$	$b = 4\ 30$
5.	Münster	$a = (28\ 0)$	$b = 7\ 30$
5.	Cranford	$a = 27\ 40$	$b = 5\ 40$
5.	Albany	$a = 27\ 0$	$b = 6\ 0$
5.	Münster	$a = 24\ 0$	$b = 4\ 24$
5.	Albany	$a = 22\ 0$	$b = 5\ 0$
5.	Altona	$a = 20\ 0$	$b = 7\ 20$
5.	Altona	$a = 16\ 40$	$b = 6\ 0$
5.	Altona	$a = 16\ 0$	$b = 6\ 40$
5.	Münster	$a = 16\ 0$	$b = 3\ 45$

Oct. 5. Aylesbury	$a =$	15° 0′	$b =$	3° 30′		
5. Worcester	$a =$	14 0	$b =$	4 40		
5. Oporto	$a =$	10 0	$b =$	2 4		
5. Münster	$a =$	8 0	$b =$	2 45		
5. Altona	$a =$	8 0	$b =$	3 40		
5. Altona	$a =$	4 0	$b =$	2 10		
5. Münster	$a =$	4 0	$b =$	1 45		
5. Poulkova	$a =$	0 26	$b =$	0 14		
5. Haddenham	$a =$	0 21	$b =$	0 14		
5. Poulkova	$a =$	0 13	$b =$	0 8		
5. Greenwich	$a =$	0 10	$b =$	0 10.3		
6. Obs. Harv. Coll.	Length of Tail	50 0				
6. Obs. Harv. Coll.	"	50 0				
6. Dorpat	"	43 0				
6. Münster	"	36 0				
6. Göttingen	"	34 0				
6. Neuchatel	"	33 30				
6. Vienna	"	30 0				
6. Obs. Harv. Coll.	$a =$	30° 0′	$b =$	6 0		
6. Obs. Harv. Coll.	$a =$	30 0	$b =$	7 0		
6. Münster	$a =$	16 0	$b =$	4 33		
6. Altona	$a =$	15 0	$b =$	6 35		
6. Breslau	$a =$	14 0	$b =$	5 0		
6. Münster	$a =$	8 0	$b =$	2 52		
7. Vienna	Length of Tail	47 0				
7. Vienna	"	46 0				
7. Poulkova	"	45 0				
7. Kremsmünster	"	44 0				
7. Poulkova	"	40 0				
7. Markree	"	40 0				
7. Kremsmünster	$a =$	30° 0′	$b =$	10 0		
7. Poulkova	$a =$	27 0	$b =$	9 0		
7. Poulkova	$a =$	19 0	$b =$	6 0		
7. Münster	$a =$	13 0	$b =$	5 30		
7. Vienna	$a =$	7 0	$b =$	1 55		
7. Vienna	$a =$	39 3	$b =$	0 15.2		
7. Vienna	$a =$	16 7	$b =$	0 12		
8. Vienna	Length of Tail	53 0				
8. Obs. Harv. Coll.	"	52 0				
8. Tretire	"	45 0				
8. Liverpool	"	35 0				

Oct. 8. Poulkova	Length of Tail	35° 0′		
8. Vienna	"	33 0		
8. Münster	"	33 0		
8. Markree	"	33 0		
8. Obs. Harv. Coll.	"	27 0		
8. Breslau	"	(20 0)		
8. Batavia	"	(16 0)		
8. Vienna	$a =$	(30° 0′)	$b =$	15 0
8. Obs. Harv. Coll.	$a =$	(25 0)	$b =$	7 0
8. Münster	$a =$	24 0	$b =$	7 0
8. Vienna	$a =$	22 0	$b =$	4 35
8. Poulkova	$a =$	20 0	$b =$	7 0
8. Tretire	$a =$	20 0	$b =$	7 0
8. Coll. Romano	$a =$	20 0	$b =$	5 24
8. Liverpool	$a =$	(24 0)	$b =$	7 30
8. Obs. Harv. Coll.	$a =$	20 0	$b =$	6 30
8. Markree	$a =$	20 0	$b =$	6 42
8. Obs. Harv. Coll.	$a =$	16 0	$b =$	6 0
8. Münster	$a =$	16 0	$b =$	4 20
8. Obs. Harv. Coll.	$a =$	8 0	$b =$	3 10
8. Münster	$a =$	8 0	$b =$	2 24
8. Coll. Romano	$a =$	8 0	$b =$	3 20
8. Obs. Harv. Coll.	$a =$	4 0	$b =$	1 40
8. Coll. Romano	$a =$	4 0	$b =$	1 52
8. Poulkova	$a =$	0 26	$b =$	0 15
8. Poulkova	$a =$	0 13	$b =$	0 13
9. Vienna	Length of Tail	58 0		
9. Poulkova	"	55 0		
9. Dorpat	"	54 0		
9. Altona	"	50 0		
9. Göttingen	"	41 0		
9. Obs. Harv. Coll.	"	41 0		
9. Hunt's Corners	"	40 0		
9. Poulkova	"	37 0		
9. Albany	"	33 0		
9. Sacramento	"	30 0		
9. Altona	"	30 0		
9. Albany	"	30 0		
9. Altona	$a =$	30° 0′	$b =$	12 0
9. Albany	$a =$	30 0	$b =$	10 0
9. Poulkova	$a =$	30 0	$b =$	10 0
9. Dorpat	$a =$	25 0	$b =$	10 0

Oct. 9.	Münster	*a* = 24° 0′	*b* = 8° 45′
9.	Poulkova	*a* = 16 0	*b* = 6 40
9.	Altona	*a* = 16 0	*b* = 7 10
9.	Münster	*a* = 16 0	*b* = 5 45
9.	Poulkova	*a* = 8 0	*b* = 3 50
9.	Altona	*a* = 8 0	*b* = 4 0
9.	Münster	*a* = 8 0	*b* = 3 12
9.	Oporto	*a* = 8 0	*b* = 1 50
9.	Oporto	*a* = 4 0	*b* = 1 25
10.	Obs. Harv. Coll.	Length of Tail	64 0
10.	Tretire	"	48 0
10.	Albany	"	43 0
10.	Albany	"	40 0
10.	Altona	"	40 0
10.	Mussoree	"	25 0
10.	Albany	*a* =(30° 0′)	*b* = 16 0
10.	Obs. Harv. Coll.	*a* = 30 0	*b* = 10 0
10.	Altona	*a* =(30 0)	*b* = 10 0
10.	Albany	*a* =(30 0)	*b* = 10 0
10.	Oporto	*a* = 24 0	*b* = 5 50
10.	Münster	*a* = 16 0	*b* = 6 0
10.	Oporto	*a* = 16 0	*b* = 5 10
10.	Albany	*a* = 9 0	*b* = 4 30
10.	Oporto	*a* = 8 0	*b* = 2 36
10.	Münster	*a* = 8 0	*b* = 3 28
11.	Vienna	Length of Tail	60 0
11.	Tretire	"	38 0
11.	Vienna	"	36 0
11.	Cambridge, Eng.	"	30 0
11.	Münster	"	29 0
11.	Vienna	*a* = 30° 0′	*b* = 18 0
11.	Tretire	*a* =(30 0)	*b* = 9 0
11.	Münster	*a* = 24 0	*b* = 9 0
11.	Vienna	*a* = 18 0	*b* = 7 0
11.	Münster	*a* = 16 0	*b* = 7 0
11.	Vienna	*a* = 9 0	*b* = 2 45
11.	Münster	*a* = 8 0	*b* = 4 20
12.	Obs. Harv. Coll.	Length of Tail	48 0
12.	Dorpat	"	36 0
12.	Altona	"	36 0
12.	Münster	"	35 0

Oct. 12.	Münster	*a* = 29° 0′	*b* = 13° 0′
12.	Münster	*a* = 24 0	*b* = 9 0
12.	Münster	*a* = 16 0	*b* = 6 20
12.	Altona	*a* = 16 0	*b* = 7 0
12.	Altona	*a* = 8 0	*b* = 4 20
12.	Münster	*a* = 8 0	*b* = 3 50
13.	Poulkova	Length of Tail	45 0
13.	Geneva	"	37 0
13.	Poulkova	"	30 0
13.	Poulkova	*a* = 24° 0′	*b* = 10 0
13.	Poulkova	*a* = 16 0	*b* = 7 30
13.	Poulkova	*a* = 8 0	*b* = 3 20
13.	Oporto	*a* = 8 0	*b* = 2 0
13.	Poulkova	*a* = 4 0	*b* = 1 35
14.	Vienna	Length of Tail	34 0
14.	Frigate Novarra	"	33 20
14.	Dorpat	"	32 0
14.	Cape of Good Hope	"	14 0
14.	Vienna	*a* =(30° 0′)	*b* = 14 0
14.	Oporto	*a* = 6 0	*b* = 1 0
15.	Vienna	Length of Tail	20 0
15.	Obs. Harv. Coll.	"	5 0
15.	Vienna	*a* =(20° 0′)	*b* = 5 0
15.	Oporto	*a* = 8 0	*b* = 1 20
16.	Vienna	Length of Tail	8 0
16.	Markree	"	3 0
16.	Vienna	*a* = (8° 0′)	*b* = 2 0
17.	Melbourne	Length of Tail	10 0
17.	Vienna	"	4 0
17.	Melbourne	*a* = 10° 0′	*b* = 1 6
17.	Melbourne	*a* = 6 0	*b* = 0 50
17.	Vienna	*a* = (4 0)	*b* = 1 0
17.	Melbourne	*a* = 4 0	*b* = 0 40
17.	Melbourne	*a* = 1 0	*b* = 0 20
17.	Clinton	*a* = 0 15	*b* = 0 10
19.	Obs. Harv. Coll.	Length of Tail	5 30
19.	Obs. Harv. Coll.	*a* = 5° 30′	*b* = 1 10

Oct. 19. Obs. Harv. Coll. $a = 2^\circ\ 0'$ $b = 0^\circ\ 35'$
19. Obs. Harv. Coll. $a = 0\ 50$ $b = 0\ 6$

21. Rio Janeiro Length of Tail 12 0
22. Cape of Good Hope " 4 0

23. Cape of G. H. $a = (2^\circ\ 0')$ $b = 0\ 8.4$

24. Melbourne Length of Tail 4 30

24. Melbourne $a = 4^\circ\ 0'$ $b = 0\ 30$

Oct. 24. Melbourne $a = 1^\circ\ 0'$ $b = 0^\circ\ 12'$

25. Obs. Harv. Coll. Length of Tail 1 0
27. Madras " 4 30
30. Cape of Good Hope " 1 30

30. Cape of G. H. $a = 0^\circ\ 45'$ $b = 0\ 7.2$

31. Cape of G. H. Length of Tail 1 24
Dec. 3. Rio Janeiro " 0 55

Having divided the observed breadths of the tail into suitable groups, they were reduced, with the aid of the provisional chart, to normal values. These have been combined in a series of curves from which the breadths required in the subsequent discussion of the data have been read off.

The following are the final results for the breadths of the tail, derived from the charts, excepting for the dates September 20th, 21st, 22d, and 23d. The numbers adopted for the extreme length of the tail are also given.

As has been before remarked, faint traces of light probably extended beyond the limits indicated on the charts for the rear outline, so that the breadths given below may be somewhat too small.

Breadth of the Tail.

Date.	Distance from Nucleus.	Breadth.	Date.	Distance from Nucleus.	Breadth.	Date.	Distance from Nucleus.	Breadth.
Sept. 16	0° 10′	0° 9′	Sept. 19	2° 0′	0° 27′	Sept. 22	6° 0′	0° 48′
	0 30	0 13		4 0	0 37			
	1 0	0 18		6 0	0 47	Sept. 23	0 10	0 8
	2 0	0 25					0 30	0 13
	4 0	0 33	Sept. 20	0 10	0 8		1 0	0 19
	6 0	0 47		0 30	0 13		2 0	0 29
				1 0	0 18		4 0	0 39
Sept. 17	0 10	0 8		2 0	0 28		6 0	0 49
	0 30	0 12		4 0	0 37			
	1 0	0 18		6 0	0 47	Sept. 24	0 10	0 8
	2 0	0 28					0 30	0 15
	4 0	0 43	Sept. 21	0 10	0 8		1 0	0 21
	6 0	0 52		0 30	0 13		2 0	0 30
				1 0	0 18		4 0	0 40
Sept. 18	0 10	0 8		2 0	0 28		6 0	0 49
	0 30	0 13		4 0	0 37		8 0	1 0
	1 0	0 18		6 0	0 48			
	2 0	0 27				Sept. 25	0 10	0 8
	4 0	0 36	Sept. 22	0 10	0 8		0 30	0 12
				0 30	0 13		1 0	0 18
Sept. 19	0 10	0 8		1 0	0 19		2 0	0 28
	0 30	0 13		2 0	0 29		4 0	0 41
	1 0	0 18		4 0	0 38		6 0	0 52

Breadth of the Tail. (*Continued.*)

Date.	Distance from Nucleus.	Breadth.	Date.	Distance from Nucleus.	Breadth.	Date.	Distance from Nucleus.	Breadth.
	° ′	° ′		° ′	° ′		° ′	° ′
Sept. 25	8 0	1 2	Sept. 30	24 0	3 16	Oct. 5	0 10	0 9
	10 0	1 17					0 30	0 16
			Oct. 1	0 10	0 8		1 0	0 26
Sept. 26	0 10	0 8		0 30	0 15		2 0	0 47
	0 30	0 13		1 0	0 23		4 0	1 20
	1 0	0 19		2 0	0 37		6 0	1 53
	2 0	0 31		4 0	0 57		8 0	2 26
	4 0	0 43		6 0	1 15		10 0	2 56
	6 0	0 54		8 0	1 32		12 0	3 30
	8 0	1 8		10 0	1 55		16 0	4 29
	10 0	1 21		12 0	2 14		20 0	5 28
				16 0	2 53		24 0	6 26
Sept. 27	0 10	0 8		20 0	3 21		30 0	7 18
	0 30	0 13		24 0	3 39			
	1 0	0 19				Oct. 6	0 10	0 8
	2 0	0 30	Oct. 2	0 10	0 9		0 30	0 17
	4 0	0 44		0 30	0 16		1 0	0 29
	6 0	0 55		1 0	0 24		2 0	0 51
	8 0	1 10		2 0	0 39		4 0	1 25
	10 0	1 28		4 0	1 2		6 0	2 6
	12 0	1 40		6 0	1 26		8 0	2 40
				8 0	1 49		10 0	3 13
Sept. 28	0 10	0 9		10 0	2 8		12 0	3 48
	0 30	0 15		12 0	2 31		16 0	4 59
	1 0	0 22		16 0	3 8		20 0	6 2
	2 0	0 33		20 0	3 50		24 0	7 6
	4 0	0 44		24 0	4 21		30 0	8 4
	6 0	0 57		30 0	5 0			
	8 0	1 11				Oct. 7	0 10	0 9
	10 0	1 31	Oct. 3	0 10	0 9		0 30	0 19
	12 0	1 45		0 30	0 16		1 0	0 29
	16 0	2 11		1 0	0 25		2 0	0 52
				2 0	0 42		4 0	1 30
Sept. 29	0 10	0 9		4 0	1 11		6 0	2 11
	0 30	0 14		6 0	1 34		8 0	2 49
	1 0	0 21		8 0	2 1		10 0	3 30
	2 0	0 33		10 0	2 23		12 0	4 6
	4 0	0 50		12 0	2 47		16 0	5 23
	6 0	1 0		16 0	3 35		20 0	6 34
	8 0	1 13		20 0	4 24		24 0	7 32
	10 0	1 33		24 0	5 11		30 0	8 51
	12 0	1 51		30 0	5 44			
	16 0	2 13				Oct. 8	0 10	0 9
	20 0	2 37	Oct. 4	0 10	0 9		0 30	0 17
				0 30	0 16		1 0	0 29
Sept. 30	0 10	0 9		1 0	0 25		2 0	0 53
	0 30	0 17		2 0	0 43		4 0	1 36
	1 0	0 24		4 0	1 14		6 0	2 13
	2 0	0 36		6 0	1 42		8 0	2 55
	4 0	0 53		8 0	2 16		10 0	3 33
	6 0	1 4		10 0	2 51		12 0	4 14
	8 0	1 22		12 0	3 20		16 0	5 36
	10 0	1 41		16 0	4 9		20 0	6 51
	12 0	2 0		20 0	5 0		24 0	8 0
	16 0	2 32		24 0	5 47		30 0	9 29
	20 0	3 1		30 0	6 23			

Breadth of the Tail. (*Concluded.*)

Date.	Distance from Nucleus.	Breadth.	Date.	Distance from Nucleus.	Breadth.	Date.	Distance from Nucleus.	Breadth.
Oct. 9	0° 10'	0° 10'	Oct. 11	20° 0'	7° 59'	Oct. 14	6° 0'	1° 47'
	0 30	0 16		24 0	9 15		8 0	2 26
	1 0	0 28		30 0	11 4		10 0	3 2
	2 0	0 52					12 0	3 40
	4 0	1 37	Oct. 12	0 10	0 10		16 0	4 39
	6 0	2 19		0 30	0 19		20 0	5 28
	8 0	3 2		1 0	0 31		24 0	6 16
	10 0	3 45		2 0	0 57		30 0	7 38
	12 0	4 29		4 0	1 48			
	16 0	5 51		6 0	2 36	Oct. 15	0 10	0 10
	20 0	7 4		8 0	3 23		0 30	0 16
	24 0	8 27		10 0	4 17		1 0	0 24
	30 0	10 22		12 0	5 10		2 0	0 39
				16 0	6 46		4 0	1 8
Oct. 10	0 10	0 10		20 0	8 17		6 0	1 27
	0 30	0 19		24 0	9 52		8 0	1 54
	1 0	0 31		30 0	12 12		10 0	2 25
	2 0	0 52					12 0	2 53
	4 0	1 39	Oct. 13	0 10	0 9		16 0	3 48
	6 0	2 24		0 30	0 17			
	8 0	3 3		1 0	0 27	Oct. 16	0 10	0 10
	10 0	3 54		2 0	0 49		0 30	0 16
	12 0	4 44		4 0	1 31		1 0	0 23
	16 0	6 15		6 0	2 17		2 0	0 35
	20 0	7 41		8 0	3 2		4 0	1 0
	24 0	9 2		10 0	3 48		6 0	1 21
	30 0	11 2		12 0	4 27		8 0	1 48
				16 0	5 32		10 0	2 13
Oct. 11	0 10	0 10		20 0	6 44			
	0 30	0 17		24 0	8 2	Oct. 17	0 10	0 10
	1 0	0 26		30 0	9 49		0 30	0 17
	2 0	0 47					1 0	0 23
	4 0	1 33	Oct. 14	0 10	0 10		2 0	0 37
	6 0	2 24		0 30	0 16		4 0	0 54
	8 0	3 13		1 0	0 26		6 0	1 15
	10 0	4 7		2 0	0 42		8 0	1 35
	12 0	5 2		4 0	1 16		10 0	1 59
	16 0	6 5						

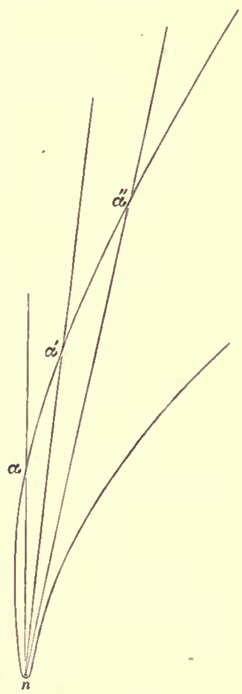
Adopted Length of the Tail.

Date.	Length of Tail.	Date.	Length of Tail.	Date.	Length of Tail.	Date.	Length of Tail.
Sept. 16	7°	Sept. 25	10°	Oct. 4	35°	Oct. 12	48°
17	8	26	10	5	40	13	45
18	5	27	14	6	50	14	34
19	8	28	19	7	51	15	20
20	6	29	22	8	53	16	10
21	8	30	26	9	58	17	9
22	9	Oct. 1	27	10	64	18	7
23	10	2	33	11	60	19	6
24	10	3	34				

The observations upon the axis and rear edge were brought forward to the front edge by applying the breadths of the tail, and were then combined with those on the front, in small groups, giving to such as belonged to points in the front, axis, and rear, nearly equidistant from the nucleus and of average precision, the relative weights 3, 2, and 1; and in other particulars giving such expression as was practicable to the relative values of individual observations, whenever the data afforded means of distinguishing between them.

Straight lines were next drawn for each date, from the nucleus as a common origin, towards the part of the chart occupied by the tail, and were extended far enough to intersect the front edge; the first of the system being drawn in the direction of the initial axis, the second in a direction inclined by an angle of 6° to the first, the third at an inclination of 12°, the fourth at an inclination of 18°, and so on, by equal increments of 6°, until the angle was such that the lines ceased to intersect the front outline of the tail.

Fig. 13.



In Fig. 13 α represents the point of intersection of the line of the initial axis prolonged; α' and α'', those of lines inclined respectively 6° and 12° to the axis. In a few instances only, this angle exceeded 48°. The reason for adopting 6° as the interval was merely that it furnished a sufficient number of intersections, distributed with tolerable uniformity along the curve.

Arcs were then drawn provisionally, so as to represent, as well as possible, a sufficient number of observations on either side of α, α', &c., and the corresponding distances of the points of intersection from the nucleus were read off. The values of $n\,\alpha$ were next projected by themselves and combined in convenient groups, having regard to their respective weights. A curve was then drawn through the normal points, so as to give a favorable representation of the entire series. The same method was applied successively to $n\,\alpha'$, $n\,\alpha''$, &c., each being in turn treated independently of the rest.

The readings from the curves furnished normal values of $n\,\alpha$, $n\,\alpha'$ . . . . ., which were projected upon the chart. Lastly, the final curve of the front edge was drawn between the normal points $\alpha, \alpha', \alpha''$ . . . . . (not, however, necessarily passing *through* them), so as to represent each as favorably as possible, without admitting contrary flexure, or any abrupt departure from the continuous sweep of the curve.

Thus, in the first instance, the numbers belonging to each system have been discussed separately; all the values of $n\alpha$ having been considered without reference to $n\alpha'$, $n\alpha''$, &c., its variations being taken simply as functions of the time. In the subsequent combination of the several values $n\alpha$, $n\alpha'$, &c., for the same date, to form a continuous curve, the distance from the nucleus has been the variable. In the assignment of the weights for combining observations, it is to be observed that equal errors, in a direction normal to the curve of the tail, will have a different influence upon the values of $n\alpha$, $n\alpha'$, &c., according to the angle at which the lines $n\alpha$, $n\alpha'$ intersect the tangents to the curve at the points α, α'. The rate of increase of this angle, which we will call $\varkappa$, is small, and beyond the distance $n\alpha = 3°$, the variation of the probable error of observations of average precision, considered as a function of the distance of the point observed from the nucleus, can be tolerably well represented by the variation of the product

$$n\alpha \ \sin. \varkappa,$$

and since an error, η, in a direction normal to the curve, will affect $n\alpha$ with an error

$$\eta \ \text{cosec.} \varkappa,$$

the probable error of $n\alpha$ will therefore be nearly proportional to

$$\eta \ \text{cosec.} \varkappa \times n\alpha \ \sin. \varkappa = \eta \ n\alpha.$$

In adjacent dates, where the time alone is the variable, the values of $n\alpha$ are nearly equal; and the relative weight to be given to an individual determination of $n\alpha$, in combining it with others of the particular series to which it belongs, depends mainly upon the number and quality of the observations which it represents, without regard to the angle $\varkappa$, at which the line drawn from the nucleus intersects the curve, or to the distance from the nucleus of the part of the tail under discussion.

After constructing the front edge, the rear outline was derived from it by means of points laid off with the normal breadths, the curve being drawn between the projected points in the same manner as for the front edge.

The outlines, constructed as here described, are represented in Plates XXIV. and XXVI. Sections I., II., III., and are to be regarded as the final results of the discussion. The group of outlines for the dates September 16, 17, 18, and 19, Plate XXV., being isolated from the remainder of the series, the systematic treatment elsewhere adopted could not be fully applied to them.

The following are the original readings for the distances $n\alpha$, $n\alpha'$, &c., and the concluded values subsequently derived from their combination, in separate groups, as distinguished from the numbers which would correspond to the final outlines of the

front edge, which are drawn as just described, so as to represent favorably all the numbers belonging to any one date, without admitting inconsistencies of flexure.

Values of $n\alpha$.

Date.			Original Readings.	Relative Weight.	Concluded Values.	Diff. c — o.
1858.	Sept.	16	$n\alpha = 2^\circ\ 47'$	3	$2^\circ\ 48'$	$+0^\circ\ 1'$
		17	4 20	1	3 0	—1 20
		18	2 55	3	3 12	+0 17
		19	2 35	4	3 23	+0 48
		24	5 10	1	4 8	—1 2
		25	4 18	1	4 13	—0 5
		26	5 5	3	4 16	—0 49
		27	4 58	2	4 18	—0 40
		28	4 30	3	4 18	—0 12
		29	5 2	3	4 17	—0 45
		30	3 15	6	4 15	+1 0
	Oct.	1	4 5	2	4 11	+0 6
		2	4 0	6	4 7	+0 7
		3	3 21	4	4 2	+0 41
		4	2 52	3	3 57	+1 5
		5	3 36	6	3 52	+0 16
		6	4 30	2	3 46	—0 44
		7	2 12	2	3 40	+1 28
		8	4 35	6	3 33	—1 2
		9	2 50	2	3 27	+0 37
		10	1 50	2	3 20	+1 30
		11	2 30	2	3 13	+0 43
		12	3 40	3	3 7	—0 33
		13	3 0	3	3 0	0 0
		14	2 0	1	2 53	+0 53
		15	3 0	3	2 45	—0 15
		16	2 0	1	2 38	+0 38
		17	3 20	2	2 30	—0 50

Values of $n\alpha'$.

Date.			Original Readings.	Relative Weight.	Concluded Values.	Diff. c — o.
1858.	Sept.	16	$n\alpha' = 5^\circ\ 34'$	3	$4^\circ\ 28'$	$-1^\circ\ 6'$
		17	8 40	1	5 3	—3 37
		18	4 46	3	5 37	+0 51
		19	4 48	4	6 10	+1 22
		24	8 45	2	8 8	—0 37

	Date.		Original Readings.	Relative Weight.	Concluded Values.	Diff. c — o.
1858.	Sept.	25	$n\alpha' = 7^\circ\ 40'$	2	$8^\circ\ 20'$	$+0^\circ\ 40'$
		26	9 5	5	8 28	—0 37
		27	8 20	3	8 32	+0 12
		28	8 0	4	8 33	+0 33
		29	8 50	5	8 32	—0 18
		30	7 33	7	8 27	—0 54
	Oct.	1	8 25	3	8 19	—0 6
		2	8 18	5	8 10	—0 8
		3	8 1	6	7 57	—0 4
		4	7 1	4	7 43	+0 42
		5	7 8	5	7 28	+0 20
		6	6 59	3	7 10	+0 11
		7	6 33	2	6 50	+0 17
		8	7 47	8	6 26	—1 21
		9	5 53	5	6 0	+0 7
		10	4 31	5	5 34	+1 3
		11	4 42	2	5 18	+0 36
		12	7 18	3	5 11	—2 7
		13	4 21	4	5 13	+0 52
		14	5 0	2	5 23	+0 23
		15	8 40	4	5 46	—2 54
		16	4 0	2	6 16	+2 16
		17	6 0	3	6 50	+0 50

Values of $n\,\alpha''$.

	Date.		Original Readings.	Relative Weight.	Concluded Values.	Diff. c — o.
1858.	Sept.	19	$n\,\alpha'' = 7^\circ\ 35'$	3	$7^\circ\ 35'$	$0^\circ\ 0'$
		24	. . .	.	. . .	. . .
		25	11 43	1	11 31	—0 12
		26	14 0	1	12 22	—1 38
		27	12 50	3	12 46	—0 4
		28	12 12	3	13 18	+1 6
		29	13 12	2	13 44	+0 32
		30	13 27	7	14 5	+0 38
	Oct.	1	14 33	3	14 16	—0 17
		2	15 38	5	14 14	—1 24
		3	14 14	3	13 55	—0 19
		4	11 13	4	13 8	+1 55
		5	10 40	8	12 0	+1 20
		6	10 37	6	10 48	+0 11
		7	10 3	1	9 30	—0 33

Date.			Original Readings.	Relative Weight.	Concluded Values.	Diff. c — o.
			° ′		° ′	° ′
1858.	Oct.	8	$n\,\alpha'' =$ 10 51	8	8 15	—2 36
		9	9 0	6	7 37	—1 23
		10	6 55	5	7 19	+0 24
		11	6 46	3	7 17	+0 31
		12	11 19	2	7 31	—3 48
		13	6 14	4	8 9	+1 55
		14	7 40	2	9 2	+1 22
		15	13 25	4	9 52	—3 33
		16	6 30	2	10 39	+4 9
		17	10 30	3	11 23	+0 53

Values of $n\,\alpha'''$.

Date.			Original Readings.	Relative Weight.	Concluded Values.	Diff. c — o.
			° ′		° ′	° ′
1858.	Sept.	27	$n\,\alpha''' =$ . . .	. .	16 52	. . .
		28	17 10	2	18 19	+1 9
		29	19 6	1	19 24	+0 18
		30	21 30	3	20 8	—1 22
	Oct.	1	21 37	3	20 29	—1 8
		2	20 40	4	20 23	—0 17
		3	20 40	3	19 51	—0 49
		4	19 0	3	19 0	0 0
		5	15 40	8	17 5	+1 25
		6	15 51	6	16 10	+0 19
		7	15 11	1	14 34	—0 37
		8	14 48	8	13 15	—1 33
		9	13 49	6	12 15	—1 34
		10	10 41	5	11 34	+0 53
		11	11 9	2	11 15	+0 6
		12	16 32	2	11 20	—5 12
		13	8 40	3	11 45	+3 5
		14	12 0	2	12 37	+0 37
		15	18 15	3	14 1	—4 14
		16	9 45	2	15 36	+5 51
		17	17 0	1	17 18	+0 18

Values of $n\,\alpha^{iv}$.

Date.			Original Readings.	Relative Weight.	Concluded Values.	Diff. c — o.
			° ′		° ′	° ′
1858.	Sept.	24	$n\,\alpha^{iv} =$ . . .	. .	22 50	. . . .
		25	. . .	. .	23 30	. . .
		26	. . .	. .	24 9	. . .
		27	. . .	. .	24 44	. . .
		28	. . .	. .	25 15	. . .

Date.			Original Readings.	Relative Weight.	Concluded Values.	Diff. c — o.
			° ′		° ′	° ′
1858.	Sept.	29	$n\,\alpha^{iv}$ = . . .	. .	25 40	. . .
		30	26 39	3	25 58	—0 41
	Oct.	1	27 9	6	26 7	—1 2
		2	24 28	6	26 5	+1 17
		3	24 15	8	25 52	+1 37
		4	27 4	8	25 20	—1 44
		5	24 21	6	24 27	+0 6
		6	22 30	8	23 10	+0 40
		7	23 18	5	21 38	—1 40
		8	20 2	12	20 9	+0 7
		9	18 38	5	19 17	+0 39
		10	17 37	5	18 32	+0 55
		11	16 38	2	18 3	+1 25
		12	23 30	2	17 45	—5 45
		13	11 53	2	17 38	+5 45
		14	16 55	2	17 37	+0 42
		15	22 0	2	17 41	—4 19
		16	. . .	. .	17 52	. . .
		17	. . .	. .	18 7	. . .

Values of $n\,\alpha^{v}$.

Date.			Original Readings.	Relative Weight.	Concluded Values.	Diff. c — o.
1858.	Oct.	2	$n\,\alpha^{v}$ = 31° 27′	6	29° 10′	—2° 17′
		3	26 35	5	29 51	+3 16
		4	31 6	5	30 21	—0 45
		5	30 45	8	30 31	—0 14
		6	29 10	6	30 10	+1 0
		7	30 58	4	29 22	—1 36
		8	25 5	8	28 19	+3 14
		9	25 14	6	26 51	+1 37
		10	26 12	6	25 11	—1 1
		11	22 49	2	23 36	+0 47
		12	30 47	4	22 11	—8 36
		13	17 10	2	20 58	+3 48
		14	23 40	2	19 55	—3 45
		15	. . .	. .	19 4	. . .
		16	. . .	. .	18 23	. . .

Values of $n\,\alpha^{vi}$.

Date.			Original Readings.	Relative Weight.	Concluded Values.	Diff. c — o.
1858.	Oct.	4	$n\,\alpha^{vi}$ = 36° 20′	4	35° 44′	—0° 36′
		5	35 42	8	35 44	+0 2

		Date.	Original Readings.	Relative Weight.	Concluded Values.	Diff. c — o.
			° ′		° ′	° ′
1858.	Oct.	6	$n\,\alpha^{vi}$ = 35 26	6	35 44	+0 18
		7	38 44	5	35 41	—3 3
		8	32 9	6	35 35	+3 26
		9	36 50	4	35 19	—1 31
		10	33 46	3	34 52	+1 6
		11	29 42	3	34 16	+4 34
		12	37 48	4	32 44	—5 4
		13	27 20	2	28 44	+1 24
		14	31 0	1	28 18	—2 42
		15	. . .	. .	28 12	. . .

Values of $n\,\alpha^{vii}$.

		Date.	Original Readings.	Relative Weight.	Concluded Values.	Diff. c — o.
			° ′		° ′	° ′
1858.	Oct.	4	$n\,\alpha^{vii}$ = . . .	. .	41 36	. . .
		5	42 27	6	41 51	—0 36
		6	41 28	5	42 10	+0 42
		7	47 33	4	42 30	—5 3
		8	42 44	6	42 55	+0 11
		9	43 50	6	43 30	—0 20
		10	39 34	4	44 14	+4 40
		11	38 0	1	45 6	+7 6
		12	47 50	1	46 8	—1 42
		13	53 0	2	47 16	—5 44
		14	40 15	1	48 17	+8 2
		15	. . .	. .	49 9	. . .
		16	. . .	. .	49 55	. . .

Values of $n\,\alpha^{viii}$.

		Date.	Original Readings.	Relative Weight.	Concluded Values.	Diff. c — o.
			° ′		° ′	° ′
1858.	Oct.	7	$n\,\alpha^{viii}$ = . . .	. .	51 21	. . .
		8	53 18	2	50 28	—2 50
		9	50 8	5	49 32	—0 36
		10	44 18	2	48 40	+4 22
		11	. . .	. .	47 43	. . .

Values of $n\,\alpha^{ix}$.

		Date.	Original Readings.	Relative Weight.	Concluded Values.	Diff. c — o.
			° ′		° ′	° ′
1858.	Oct.	7	$n\,\alpha^{ix}$ = . . .	. .	57 22	. . .
		8	. . .	. .	56 21	. . .
		9	58 2	4	55 20	—2 42
		10	48 55	2	54 20	+5 25
		11	. . .	. .	53 19	. . .

Occasional peculiarities met with in the data, or which have occurred in the process of reduction, are explained in the following remarks.

1858. September 16. The stars used as points of reference in transferring the outlines from the Poulkova chart* are the following. They are referred to the mean equinox for 1858.0, that of the original sketch being for 1800.0.

		Mag.	α 1858.0.	δ 1858.0.
Histoire Céleste	21900	7–8	171° 9′	+39° 43′
	21913	7–8	171 18	39 39
	21919	7–8	171 22	40 6
	21926	7–8	171 24	39 39
	21947	7	171 36	37 36
	21975	8–9	171 55	36 11
	21994	9–10	172 10	+36 55

t has been assumed to satisfy the position of the nucleus and initial axis.

I have inferred from the Dorpat observation that the angle of position of the bright edge of the tail at 5° from the nucleus was 346° 10′. If we suppose Mädler's description to refer to the part of the outline between 3° and 4° from the nucleus, it will accord with the Poulkova chart. The axis of the Poulkova figure with the neighboring star was traced and enlarged to the scale of Plate XXVI., in the proportion 1.222 : 1.000, and after having been transferred, the front and rear edges were supplied by means of the normal breadths.

1858. September 17. From the Kingston observation I have concluded that the direction of the front edge at 3° from the nucleus was towards a point in α 170° 0′, δ 47° 0′, half-way between χ and ψ Ursæ Majoris, bringing the general direction of the tail "nearer to ψ." From this the axis, assumed to be a circular arc, has been drawn, and a provisional front edge constructed by means of the known breadths of the tail. The observed values of $n\alpha$ and $n\alpha'$ have been read off from this outline, but for the final outlines on Plate XXVI., the normal values of $n\alpha$ and $n\alpha'$ and of the breadths were used.

The results on this date have but a small independent weight.

1858. September 18. On this date, as well as on the 16th and 19th, the reduction for precession from the equinox of Harding's chart, which was used for the drawings of the Comet made at Poulkova, has been allowed for by the method used in transferring the outlines.

* Pulk. Beob., Tab. VI. Fig. 1. It will be noticed, that among the Poulkova observations the positions read off from Harding's atlas are referred to the equinox of 1800.0.

The axis on the 18th has been transferred from the Poulkova chart,* and the outlines supplied from it by means of the normal breadths at this date.

From the place of the nucleus and initial axis, we have $t = 0^d.03$.

The stars used in the transfers for the 18th and 19th were

		Mag.	α 1858.0.	δ 1858.0.
Histoire Céleste	22142	9	173° 40′	+40° 27′
	22171	6–7	174 0	42 31
	22195	8	174 12	39 19
	22229	7–8	174 32	36 41
	22234	9	174 37	37 4
	22261	9–10	174 53	40 18
	22355	9	175 54	37 41
	22357	. . .	175 56	+37 38

1858. September 19. The transfer has been made from the Poulkova charts,† as on the 16th and 18th. The curve in Table I. is a little flatter than in Table VI. The reference stars being distant, the position of the tail is not defined with the same exactness; I have, therefore, given a relative weight of 2 to the latter figure. For Table VI. Fig. 3, $t = 0^d.00$. Table I. does not afford a reliable epoch; the value $t = 0^d.00$ has been assumed.

The Poulkova charts, from September 16th to 19th inclusive, form a valuable group of early observations. From the 19th up to the 24th the data are not sufficient for tracing the outlines. On and after the latter date, the outlines have been drawn from the *normal* values of $n\alpha$, $n\alpha'$, &c., as has been already described. The remarks which follow have reference to the construction of the provisional curves from which the so-called *observed* values of $n\alpha$, $n\alpha'$, &c. have been taken.

1858. September 24. The sketch made at the Observatory of Harvard College has supplied the original data. The tangent to the front edge, at 9° from the nucleus, has been directed towards γ Ursæ Majoris.

1858. September 25. The curve of the axis has been adjusted so that the tangent, at 9° 30′ from the nucleus, passed through γ Ursæ Majoris.

1858. September 26. In the Oporto sketch, the axis passes midway between the stars 8 and 9 Canum Venaticorum. The stars 4, 10, and 12 of the same constellation, and the principal stars of Ursa Major were also recognized in the sketch.

The Poulkova positions having been read off from Harding's star chart, they

* Pulk. Beob., Tab. VI. Fig. 2.

† Pulk. Beob., Tab. I., and Tab. VI. Fig. 3.

have been brought forward by the addition of precession from the epoch 1800.0 to 1858.0.

1858. September 27. Several sketches made at the Observatory of Harvard College have been employed.

1858. September 28. The principal data have been derived from the observations at Altona and Markree, and from the Altona figure.

1858. September 29. There is considerable uncertainty as to the hour to which the Poulkova positions correspond. In the Vienna description, *f* Can. Ven. (14 Can. Ven.) of 5th magnitude is probably a mistake for 15 and 17 Can. Ven., which together form a single star to the naked eye, of the same brightness with 14 Can. Ven. The latter was in the rear edge of the tail at the time. The substitution of 15 and 17 for *f* brings the observation into agreement with others.

The Poulkova positions have been corrected for precession from the epoch 1800.0

1858. September 30. The observations are numerous, and offer, in general, a satisfactory agreement with each other. The Poulkova figure * indicates a faint light extending *above* the stars ζ and ε Ursæ Majoris, in this particular differing from other sketches and descriptions. It is probably a mere accident of drawing or engraving, as the text † states expressly that the last trace of the tail reached only to a distance of 25° from the nucleus, or 10° less than is shown in the figure.

The question whether the tail actually passed over these stars, or fairly below them, is one of some importance.

1858. October 1, 2, and 4. Several of the accounts for the 1st and 2d describe the end of the tail as reaching to η Ursæ Majoris. The same remark is found as late as the 4th. The star, being the nearest bright one, would naturally be so referred to in a general description, without a precise definition of its position being intended. The testimony to the effect that the front edge went a very little below the star as late as the 2d, and reached it only on the 3d, is sufficiently explicit. On the 4th, it (the star) was enveloped in the tail, but the axis of brightness probably passed near it.

The Markree position of the end of the tail on the 4th I have supposed to refer to the extremity of the axis. In the notes from the observations at Münster, *c* and *k* are probably misprints for ι and $\varkappa$; in those at Vienna, *i* Boötis is obviously a misprint for ι.

* Pulk. Beob., Tab. I.

† Pulk. Beob. des Gr. Cometen, p. 8.

1858. October 3. To represent the Breslau description, the outline of faintest light has been supposed to pass between η Ursæ Majoris and λ Boötis, at a distance of $\frac{3}{8}$ $(\eta - \lambda)$ from the latter.

1858. October 5. The fulness of the data on this and a few subsequent dates is to be noticed.

1858. October 6. The remark by Galle at Breslau, that the left-hand edge ended between δ and β Boötis, but nearer to the latter, has been represented by drawing this outline through a point distant from β by $\frac{1}{4}$ $(\beta - \delta)$. There is a difficulty in interpreting the Münster position α 220°, $\delta + 31°$, the point not being near the curve, and also in the Dorpat description.

1858. October 7. A sudden spreading out of the rear edge is mentioned by more than one observer, but the remarks are not sufficiently definite to admit of a representation on the chart.

1858. October 8. In the Vienna notes, if for ψ Boötis we read ψ Herculis (ν^1 and ν^2 Boötis), the description will accord with others. The sketches show a very strong deflection of the axis of light from a point near α Coronæ Borealis, near which the bright part of the tail terminates abruptly. The outlines on the chart are designed to include the limits of faint nebulosity which extended above the brighter deflected portion.

1858. October 9. On this and subsequent dates the diffusion of the light in the more distant parts of the tail, and the interruption of its outline caused by the faintly exhibited columnar masses, have added to the difficulty of tracing the outlines.

1858. October 10. The observation by Webb at Tretire respecting the deflected portion has been supposed to refer to its central part. His description of it, as a "scattered and abandoned vapor," is quite applicable to the whole region covered by the upper half of the tail.

1858. October 11. There is some confusion in the names of the stars cited in the Vienna and Tretire descriptions.

1858. October 12. The lower portion of the tail in the chart by Heis corresponds best to $t = -0^d.095$, which is later than we can suppose the drawing to have been made, since at that time a large part of the Comet had set. A mean between $t = -0^d.095$ and $t = -0^d.212$ has been adopted, the latter agreeing with the hour marked on the chart, but the results are not entitled to full weight.

1858. October 24. In the sketch made at Williamstown, Australia, the tail reaches to a bright cluster in the Milky Way in $\alpha = 265° 50'$, $\delta = -34° 42'$.

The right ascensions and declinations of points on the outlines of the tail, read off from the charts, and representing the final results of the discussion, are contained in the following table.

The deviations of the chart outlines from the original observations will be found in Section IV.

Concluded Right Ascensions and Declinations of Points in the Front and Rear Outlines of the Tail of the Great Comet of 1858, *at* 7ʰ *m. s. t. Observatory of Harvard College.*

Date.	Distance from Nucleus.	Front Edge. α 1858.0.	Front Edge. δ 1858.0.	Rear Edge. α 1858.0.	Rear Edge. δ 1858.0.
	° ′	° ′	° ′	° ′	° ′
Sept. 16	0 0	171 53	+36 29	. . .	. . .
	0 30	171 59	37 0	171 42	+36 59
	1 0	171 58	37 27	171 35	37 26
	2 0	171 49	38 29	171 17	38 25
	4 0	171 12	40 27	170 28	40 19
	6 0	170 23	42 20	169 22	42 7
	End.	169 50	43 22	168 43	42 57
Sept. 17	0 0	173 6	36 28	. . .	. . .
	0 30	173 10	37 0	172 55	36 59
	1 0	173 10	37 27	172 47	37 26
	2 0	173 4	38 29	172 28	38 25
	4 0	172 28	40 27	171 32	40 18
	6 0	171 20	42 19	170 11	42 1
	8 0	169 36	44 6	. . .	. . .
	End.	169 35	44 6	. . .	. . .
Sept. 18	0 0	174 25	36 27	. . .	. . .
	0 30	174 30	36 57	174 14	36 57
	1 0	174 31	37 25	174 8	37 23
	2 0	174 23	38 26	173 48	38 23
	4 0	173 41	40 25	172 54	40 16
	End.	173 8	41 23	. . .	. . .
Sept. 19	0 0	175 46	36 22	. . .	. . .
	0 30	175 51	36 53	175 35	36 52
	1 0	175 51	37 20	175 26	37 19
	2 0	175 42	38 21	175 7	38 18
	4 0	175 2	40 20	174 16	40 13
	6 0	174 3	42 13	173 0	41 58
	8 0	172 40	44 5	. . .	. . .
	End.	172 35	44 10	. . .	. . .
Sept. 24	0 0	184 0	35 7	. . .	. . .
	0 30	184 11	35 38	183 53	35 38
	1 0	184 17	36 5	183 51	36 5
	2 0	184 22	37 6	183 44	37 6
	4 0	184 13	39 8	183 21	39 6
	6 0	183 50	41 8	182 46	41 3
	8 0	183 9	43 6	181 49	+42 56
	10 0	182 14	45 1	. . .	. . .
	End.	182 14	+45 1	. . .	. . .

Date.	Distance from Nucleus.	Front Edge. α 1858.0.	Front Edge. δ 1858.0.	Rear Edge. α 1858.0.	Rear Edge. δ 1858.0.
	° ′	° ′	° ′	° ′	° ′
Sept. 25	0 0	186 5	+34 35	. . .	. . .
	0 30	186 15	35 4	186 0	+35 5
	1 0	186 22	35 32	186 0	35 34
	2 0	186 29	36 34	185 54	36 35
	4 0	186 28	38 36	185 35	38 35
	6 0	186 6	40 34	184 59	40 29
	8 0	185 26	42 35	184 0	42 25
	10 0	184 31	44 29	. . .	. . .
	End.	184 30	44 30	. . .	. . .
Sept. 26	0 0	188 13	33 53	. . .	. . .
	0 30	188 24	34 23	188 9	34 24
	1 0	188 31	34 51	188 8	34 53
	2 0	188 41	35 51	188 3	35 52
	4 0	188 46	37 55	187 52	37 55
	6 0	188 33	39 53	187 22	39 51
	8 0	188 5	41 56	186 27	41 49
	10 0	187 16	43 50	. . .	. . .
	End.	187 16	43 50	. . .	. . .
Sept. 27	0 0	190 28	33 7	. . .	. . .
	0 30	190 40	33 36	190 24	33 37
	1 0	190 46	34 2	190 24	34 5
	2 0	190 56	35 3	190 22	35 6
	4 0	191 8	37 6	190 13	37 8
	6 0	191 5	39 6	189 54	39 6
	8 0	190 43	41 9	189 8	41 5
	10 0	190 10	43 5	188 8	42 55
	12 0	189 14	45 5	186 49	44 46
	End.	188 8	47 2	. . .	. . .
Sept. 28	0 0	192 48	32 8	. . .	. . .
	0 30	193 4	32 36	192 47	32 39
	1 0	193 14	33 5	192 49	33 8
	2 0	193 31	34 4	192 52	34 9
	4 0	193 47	36 7	192 52	36 11
	6 0	193 51	38 7	192 38	38 10
	8 0	193 44	40 10	192 6	40 11
	10 0	193 24	42 9	191 21	42 5
	12 0	192 49	44 11	190 20	44 1
	16 0	190 47	48 7	187 23	+47 38
	End.	188 7	+50 58	. . .	. . .

Concluded Right Ascensions and Declinations of Points in the Outlines of the Tail. (*Continued.*)

Date.	Distance from Nucleus.	Front Edge. α 1858.0.	Front Edge. δ 1858.0.	Rear Edge. α 1858.0.	Rear Edge. δ 1858.0.
	° '	° '	° '	° '	° '
Sept. 29	0 0	195 20	+31 0	...	...
	0 30	195 36	31 27	195 19	+31 30
	1 0	195 45	31 54	195 22	31 58
	2 0	196 4	32 53	195 28	33 0
	4 0	196 29	34 56	195 31	35 3
	6 0	196 40	36 56	195 23	37 1
	8 0	196 36	39 2	195 0	39 5
	10 0	196 25	41 0	194 22	41 0
	12 0	196 4	43 1	193 29	42 56
	16 0	194 36	47 3	191 11	46 45
	20 0	191 59	50 56	187 40	50 17
	End.	190 4	52 41	...	...
Sept. 30	0 0	197 56	29 38	...	...
	0 30	198 16	30 5	197 57	30 9
	1 0	198 27	30 30	198 0	30 36
	2 0	198 53	31 29	198 8	31 38
	4 0	199 24	33 29	198 20	33 40
	6 0	199 40	35 29	198 19	35 39
	8 0	199 52	37 32	198 7	37 42
	10 0	199 52	39 34	197 40	39 42
	12 0	199 44	41 39	196 59	41 41
	16 0	198 49	45 42	195 3	45 34
	20 0	197 10	49 43	192 19	49 17
	24 0	194 3	53 35	188 20	52 45
	End.	192 0	55 17	...	...
Oct. 1	0 0	200 44	28 2	...	...
	0 30	201 3	28 28	200 47	28 34
	1 0	201 17	28 54	200 52	29 1
	2 0	201 41	29 52	201 1	30 2
	4 0	202 20	31 50	201 15	32 3
	6 0	202 46	33 47	201 18	34 2
	8 0	203 3	35 52	201 9	36 6
	10 0	203 12	37 51	200 49	38 6
	12 0	203 15	39 56	200 20	40 8
	16 0	202 52	44 0	198 45	44 5
	20 0	201 40	48 9	196 17	47 51
	24 0	199 11	52 10	192 48	51 29
	End.	196 25	54 48	...	...
Oct. 2	0 0	203 35	26 12	...	...
	0 30	203 56	26 37	203 39	26 42
	1 0	204 10	27 0	203 46	27 11
	2 0	204 41	27 57	203 58	28 11
	4 0	205 26	29 51	204 19	30 9
	6 0	206 3	31 50	204 26	32 12
	8 0	206 31	33 48	204 25	34 12
	10 0	206 55	35 52	204 16	36 16
	12 0	207 9	37 49	203 59	38 13
	16 0	207 11	42 0	202 48	42 18
	20 0	206 30	46 9	200 45	46 12
	24 0	204 50	50 21	197 28	49 57
	30 0	198 46	56 13	188 51	+54 31
	End.	195 31	+58 5	...	...
Oct. 3	0 0	206 34	+24 7	...	...
	0 30	206 57	24 29	206 41	+24 36
	1 0	207 14	24 53	206 49	25 4
	2 0	207 46	25 46	207 1	26 2
	4 0	208 40	27 35	207 25	28 0
	6 0	209 27	29 33	207 40	30 1
	8 0	210 6	31 30	207 47	32 3
	10 0	210 38	33 30	207 47	34 3
	12 0	211 3	35 27	207 35	36 6
	16 0	211 28	39 38	206 38	40 13
	20 0	211 11	43 46	204 41	44 6
	24 0	210 4	47 56	201 44	47 51
	30 0	205 50	54 8	194 53	52 58
	End.	200 17	58 3	...	...
Oct. 4	0 0	209 34	21 47	...	...
	0 30	210 0	22 8	209 46	22 16
	1 0	210 19	22 29	209 56	22 42
	2 0	210 57	23 21	210 16	23 41
	4 0	211 58	25 5	210 46	25 36
	6 0	212 51	26 58	211 1	27 34
	8 0	213 36	28 54	211 10	29 40
	10 0	214 17	30 52	211 7	31 42
	12 0	214 50	32 51	210 58	33 41
	16 0	215 33	36 59	210 19	37 49
	20 0	215 42	41 5	208 50	41 48
	24 0	215 13	45 16	206 21	45 39
	30 0	212 7	51 43	200 36	51 7
	End.	205 49	57 34	...	...
Oct. 5	0 0	212 40	19 8	...	...
	0 30	213 6	19 27	212 52	19 36
	1 0	213 26	19 46	213 4	20 1
	2 0	214 8	20 32	213 27	20 59
	4 0	215 22	22 13	214 7	22 54
	6 0	216 27	23 58	214 34	24 51
	8 0	217 22	25 50	214 50	26 51
	10 0	218 10	27 45	215 1	28 53
	12 0	218 51	29 41	215 0	30 55
	16 0	219 58	33 50	214 32	35 5
	20 0	220 38	37 54	213 29	39 9
	24 0	220 50	42 3	211 38	43 7
	30 0	219 37	48 35	...	...
	36 0	216 8	54 14	...	...
	End.	207 35	61 36	...	...
Oct. 6	0 0	215 49	16 16	...	...
	0 30	216 16	16 30	216 3	16 43
	1 0	216 38	16 48	216 17	17 6
	2 0	217 25	17 29	216 44	18 1
	4 0	218 46	19 3	217 28	19 52
	6 0	220 0	20 45	218 3	21 52
	8 0	221 3	22 34	218 25	23 52
	10 0	221 56	24 28	218 38	25 54
	12 0	222 43	+26 22	218 43	+27 54

Concluded Right Ascensions and Declinations of Points in the Outlines of the Tail. (*Continued.*)

Date.	Distance from Nucleus.	Front Edge.		Rear Edge.	
		α 1858.0.	δ 1858.0.	α 1858.0.	δ 1858.0.
Oct. 6	16° 0′	224° 8′	+30° 25′	218° 33′	+32° 8′
	20 0	225 15	34 25	217 51	36 13
	24 0	226 0	38 30	216 37	40 15
	30 0	226 1	44 59	213 31	46 20
	38 0	223 17	52 47	. . .	. . .
	46 0	218 10	60 16	. . .	. . .
	End.	211 10	66 10	. . .	. . .
Oct. 7	0 0	218 54	13 6	. . .	. . .
	0 30	219 24	13 17	219 12	13 32
	1 0	219 48	13 33	219 27	13 56
	2 0	220 38	14 13	220 0	14 49
	4 0	222 5	15 40	220 50	16 38
	6 0	223 24	17 18	221 31	18 35
	8 0	224 34	19 3	221 59	20 35
	10 0	225 36	20 51	222 17	22 36
	12 0	226 30	22 41	222 26	24 39
	16 0	228 12	26 36	222 31	28 48
	20 0	229 38	30 31	222 17	32 57
	24 0	230 41	34 34	221 25	37 3
	30 0	231 31	41 3	218 54	43 16
	38 0	230 29	49 0	. . .	. . .
	46 0	227 43	56 49	. . .	. . .
	End.	224 6	63 56	. . .	. . .
Oct. 8	0 0	222 3	9 49	. . .	. . .
	0 30	222 32	9 59	222 23	10 12
	1 0	222 58	10 12	222 41	10 36
	2 0	223 50	10 43	223 14	11 22
	4 0	225 23	12 4	224 13	13 12
	6 0	226 45	13 42	224 56	15 9
	8 0	227 58	15 24	225 27	17 10
	10 0	229 0	17 13	225 48	19 11
	12 0	230 1	19 7	225 59	21 17
	16 0	231 46	22 51	226 13	25 21
	20 0	233 26	26 40	226 11	29 29
	24 0	234 55	30 33	225 51	33 35
	30 0	236 34	36 47	224 24	39 54
	38 0	237 7	44 46	. . .	. . .
	46 0	236 2	52 44	. . .	. . .
	End.	233 23	62 24	. . .	. . .
Oct. 9	0 0	225 8	6 24	. . .	. . .
	0 30	225 37	6 30	225 30	6 45
	1 0	226 6	6 41	225 51	7 5
	2 0	227 1	7 6	226 30	7 49
	4 0	228 40	8 16	227 37	9 30
	6 0	230 9	9 43	228 27	11 23
	8 0	231 30	11 18	229 6	13 23
	10 0	232 46	13 2	229 40	15 24
	12 0	233 58	14 46	230 8	17 25
	16 0	236 8	18 16	230 50	21 26
	20 0	238 7	21 54	231 12	25 33
	24 0	239 55	25 43	231 9	29 43
	30 0	242 10	+31 50	230 9	+36 9

Date.	Distance from Nucleus.	Front Edge.		Rear Edge.	
		α 1858.0.	δ 1858.0.	α 1858.0.	δ 1858.0.
Oct. 9	38° 0′	244° 16′	+39° 36′	. . .	. . .
	46 0	244 48	47 37	. . .	. . .
	54 0	243 29	55 36	. . .	. . .
Oct. 10	0 0	228 13	2 48	. . .	. . .
	0 30	228 44	2 50	228 37	+ 3 7
	1 0	229 11	2 58	228 58	3 26
	2 0	230 5	3 22	229 41	4 7
	4 0	231 51	4 24	230 53	5 46
	6 0	233 25	5 47	231 51	7 36
	8 0	234 50	7 18	232 38	9 32
	10 0	236 13	8 54	233 13	11 30
	12 0	237 31	10 33	233 45	13 33
	16 0	239 53	13 53	234 33	17 33
	20 0	242 7	17 24	235 4	21 41
	24 0	244 3	21 7	235 18	25 51
	30 0	246 49	26 58	235 6	+32 16
	38 0	249 46	34 35	. . .	. . .
	46 0	251 7	42 27	. . .	. . .
	54 0	250 2	+50 21	. . .	. . .
Oct. 11	0 0	231 10	− 0 43	. . .	. . .
	0 30	231 40	0 45	231 35	− 0 27
	1 0	232 10	0 39	232 2	− 0 14
	2 0	233 7	− 0 21	232 49	+ 0 22
	4 0	234 52	+ 0 33	234 7	1 54
	6 0	236 35	1 46	235 8	3 43
	8 0	238 8	3 6	236 0	5 38
	10 0	239 36	4 35	236 40	7 40
	12 0	241 0	6 11	237 14	9 42
	16 0	243 32	9 25	238 14	13 38
	20 0	245 52	12 54	238 59	17 43
	24 0	247 56	16 33	239 24	21 51
	30 0	250 51	22 19	239 8	+28 25
	38 0	254 5	29 48	. . .	. . .
	48 0	257 2	+39 31	. . .	. . .
Oct. 12	0 0	234 1	− 4 17	. . .	. . .
	0 30	234 33	4 19	234 28	− 4 1
	1 0	235 2	4 16	234 52	3 46
	2 0	236 0	4 3	235 39	3 11
	4 0	237 50	3 14	237 1	− 1 37
	6 0	239 35	2 5	238 7	+ 0 4
	8 0	241 14	− 0 47	239 5	1 56
	10 0	242 48	+ 0 33	239 54	3 49
	12 0	244 17	2 2	240 36	5 48
	16 0	247 0	5 6	241 45	9 43
	20 0	249 26	8 27	242 36	13 48
	24 0	251 39	12 1	243 6	17 57
	30 0	254 53	17 35	243 24	+24 25
	38 0	258 33	24 48	. . .	. . .
	47 0	262 54	+32 55	. . .	. . .
Oct. 13	0 0	236 46	− 7 38	. . .	. . .
	0 30	237 15	− 7 42	237 13	− 7 25

Concluded Right Ascensions and Declinations of Points in the Outlines of the Tail. (*Concluded.*)

Date.	Distance from Nucleus.	Front Edge.		Rear Edge.		Date.	Distance from Nucleus.	Front Edge.		Rear Edge.	
		α 1858.0.	δ 1858.0.	α 1858.0.	δ 1858.0.			α 1858.0.	δ 1858.0.	α 1858.0.	δ 1858.0.
Oct. 13	1° 0′	237° 45′	— 7° 41′	237° 39′	— 7° 12′	Oct. 15	0° 0′	242° 0′	—14° 0′	. . .	. . .
	2 0	238 43	7 30	238 30	6 43		0 30	242 30	14 6	242 30	—13 48
	4 0	240 38	6 54	240 3	5 28		1 0	243 1	14 6	242 58	13 39
	6 0	242 32	6 3	241 28	4 0		2 0	244 6	14 0	243 54	13 21
	8 0	244 18	4 59	242 43	2 19		4 0	246 15	13 33	245 54	12 36
	10 0	245 59	3 46	243 50	— 0 35		6 0	248 6	12 57	247 36	11 36
	12 0	247 33	— 2 20	244 50	+ 1 17		8 0	249 54	12 18	249 12	10 31
	16 0	250 21	+ 0 42	246 33	4 58		10 0	251 40	11 18	250 36	8 58
	20 0	252 56	4 2	248 0	8 53		12 0	253 56	9 34	251 54	7 20
	24 0	255 26	7 20	249 13	12 52		16 0	256 29	7 6	254 0	3 45
	30 0	259 6	12 35	251 1	+18 55						
	38 0	263 31	19 19	. . .	. . .	Oct. 16	0 0	244 24	16 54	. . .	. . .
	46 0	268 9	+26 4	. . .	. . .		0 30	244 54	16 58	244 54	16 42
							1 0	245 24	16 58	245 23	16 36
Oct. 14	0 0	239 29	—10 54	. . .	. . .		2 0	246 30	16 57	246 27	16 18
	0 30	240 0	11 0	239 57	—10 43		4 0	248 48	16 36	248 36	15 35
	1 0	240 27	11 3	240 26	10 36		6 0	250 36	16 6	250 18	14 45
	2 0	241 33	10 55	241 25	10 13		8 0	252 30	15 28	252 0	13 48
	4 0	243 39	10 19	243 17	9 3		10 0	254 49	14 41	253 30	12 30
	6 0	245 23	9 38	244 39	7 45						
	8 0	247 11	8 35	246 0	6 16	Oct. 17	0 0	246 45	19 35	. . .	. . .
	10 0	248 51	7 24	247 12	4 36		0 30	247 16	19 42	247 16	19 23
	12 0	250 24	6 6	248 24	— 2 57		1 0	247 48	19 45	247 48	19 20
	16 0	253 21	— 3 0	250 23	+ 0 36		2 0	248 55	19 43	248 54	19 6
	20 0	255 58	+ 0 18	251 57	4 30		4 0	251 12	19 26	251 4	18 26
	24 0	258 9	4 12	253 5	8 45		6 0	253 6	19 0	252 48	17 48
	30 0	260 51	+10 0	254 12	+15 11		8 0	255 0	18 24	254 30	16 50
							10 0	256 54	—17 44	256 12	—15 45

IV. PROBABLE ERRORS OF OBSERVATIONS UPON THE TAIL.

THE principal sources of error in the observations upon the figure and position of the front edge of the tail of the Comet may be conveniently classed in four divisions, which will be considered separately, by giving to the relative weight of an observation upon this outline the form

$$w = g \times g' \times g'' \times g''' . \tag{1}$$

In g will be included such numerical expression as is practicable for conditions affecting in a similar way observations upon all parts of the tail, without following any recognized law connecting them with the time, as, for instance, the

degree of care apparent in a description or drawing, the method of observation, and any particulars which may have been mentioned respecting its exactness, the clearness of the sky, the amount of twilight or moonlight, or other accidental disturbing influence.

g' has been introduced as a means of discriminating between the weights given to determinations of isolated points (such, for instance, as the distance of the outline from a star near it) and the weight which should be attributed to points adopted from the continuous curves transferred from drawings. Of the latter, those which contain stars in or near the tail are the most valuable, while others give the figure alone, or with but few and distant stars. The proximity of any parts of the curve to good reference stars must be allowed to influence the value given to g'. It must also be diminished proportionally with the increase of the number of points derived from any single drawing, otherwise there would be danger of giving undue importance to the drawing, should the number of transferred points be very large. Other circumstances have also been taken into account, but it would be difficult to comprehend them under a general form of statement; indeed, in many instances, from the want of data for adjusting them, the numbers assigned both to g and g' have been little else than arbitrary.

The factor g'' has been used to express the effect upon the precision of the observations of the increasing diffusion and dimness of the outline, in proceeding from the nucleus toward the end of the tail. The collection of observed breadths of the tail has furnished the means of determining g''.

Changes of w, not included in g, applying equally to observations throughout the entire extent of the tail, and varying as functions of the time, will be included in g'''.

For points on the rear edge and in the axis, it has been assumed that the weight of an observation on the front edge is greater than that of an observation on the rear, at the same distance from the nucleus, and determined under similar circumstances, in the constant ratio $h' : 1$, and for the axis, in the ratio $h'' : 1$. The weights corresponding become

$$w' = \frac{g \times g' \times g'' \times g'''}{h'}; \qquad w'' = \frac{g \times g' \times g'' \times g'''}{h''}.$$

As has been already stated, the values assumed in the reductions have been

$$(2) \qquad h' = 3 \qquad h'' = 2$$

The deviations of observed points from the normal curves on the front and rear edges, represented by E and E', have given the approximate value

$$(3) \qquad h' = \frac{N}{N'} \cdot \frac{\Sigma \cdot \frac{w' E'^2}{g'''}}{\Sigma \cdot \frac{w E^2}{g'''}} = 2.04;$$

where N and N' are the number of values of E and E'. The positions on the rear edge are too few, however, to afford an entirely reliable result, and there are sufficient indications that this value of h' is too small to be taken as an index of the relative superiority of observations upon the front outline.

The following discussion of the differences between the observed and the normal breadths of the tail shows that the errors of observations upon the outlines, under similar circumstances, increase in the same proportion with the increase of the angular distance of the point observed from the nucleus.

From two hundred and ninety-five observed breadths of the tail at various distances, we obtain the following arithmetical means of the discrepancies $c - o$ between the normal and the observed breadths, taken without regard to signs.

Mean Date.		a	$c - o$	No. of Obs.
1858. Sept.	25	$a = 0°.015$	$c - o = 0'.90$	No. of Obs. = 25
	29	= 0.120	= 1.40	= 24
Oct.	2	= 0.580	= 2.10	= 21
Sept.	23	= 1.000	= 3.16	= 25
Oct.	6	= 1.000	= 2.44	= 25
Sept.	26	= 5.000	= 10.76	= 25
Oct.	2	= 5.000	= 22.85	= 20
	11	= 5.000	= 28.88	= 25
Sept.	30	= 14.000	= 46.70	= 20
Oct.	4	= 14.000	= 62.60	= 20
	11	= 14.000	= 40.80	= 20
	10	= 28.000	= 98.30	= 20
	4	= 30.000	= 83.80	= 25

In these numbers no direct connection is apparent between the variations of $c - o$ and the time, so that for the present purpose we may disregard g, g', and g''', and consider $c - o$ as corresponding to an observation of the average precision. It is evident, then, that $c - o$ may be approximately represented by an expression of the form

$$c - o = m + a\, m',$$

in which m and m' are constant. To determine their values, we have the equations, using $1'$ for the unit of a,

$$0 = -\ 0'.90 + m + 0.015\ m' \qquad \text{Log. Relative Weight} = 1.95$$
$$0 = -\ 1.40 + m + 0.120\ m' \qquad \text{"} = 1.70$$
$$0 = -\ 2.10 + m + 0.580\ m' \qquad \text{"} = 1.02$$
$$0 = -\ 3.16 + m + 1.000\ m' \qquad \text{"} = 0.00$$
$$0 = -\ 2.44 + m + 1.000\ m' \qquad \text{"} = 0.00$$
$$0 = -\ 10.76 + m + 5.000\ m' \qquad \text{"} = 8.60$$
$$0 = -\ 22.85 + m + 5.000\ m' \qquad \text{"} = 8.60$$
$$0 = -\ 28.88 + m + 5.000\ m' \qquad \text{"} = 8.60$$
$$0 = -\ 46.70 + m + 14.000\ m' \qquad \text{"} = 7.71$$
$$0 = -\ 62.60 + m + 14.000\ m' \qquad \text{"} = 7.71$$
$$0 = -\ 40.80 + m + 14.000\ m' \qquad \text{"} = 7.71$$
$$0 = -\ 98.30 + m + 28.000\ m' \qquad \text{"} = 7.10$$
$$0 = -\ 83.80 + m + 30.000\ m' \qquad \text{"} = 7.05$$

For the first three equations, depending principally upon telescopic observations, the weights have been derived from such estimates as could be formed of the probable errors of $c - o$. For the rest, these errors have been supposed to be proportional to the corresponding value of a. The solution of these equations gives

$$m = 0'.80 \qquad\qquad m' = 3'.30\,;$$

so that the general expression for $c - o$, irrespective of its sign, is

$$c - o = 0'.80 + 3'.30\ a, \tag{4}$$

where a is the angular distance from the nucleus, expressed in degrees, and $c - o$ the arithmetical mean of the discrepancies between the observed and the normal breadths of the tail.

By substituting m and m' in the original equations, we have the following differences between the observed and computed mean values of $c - o$.

Distance from Nucleus.	Observed $c - o$.	Computed $c - o$.	Computed — Observed.	(Comp. — Obs.) × $\sqrt{\text{Weight}}$.
$a = 0^\circ.015$	$0'.90$	$0'.85$	$-\ 0'.05$	$0'.47$
0.120	1.40	1.20	$-$ 0.20	1.42
0.580	2.10	2.71	+ 0.61	1.97
1.	3.16	4.10	+ 0.94	0.94
1.	2.44	4.10	+ 1.66	1.66
5.	10.76	17.30	+ 6.54	1.31
5.	22.85	17.30	$-$ 5.55	1.11
5.	28.88	17.30	$-$ 11.58	2.32
14.	46.70	46.20	$-$ 0.50	0.03
14.	62.60	46.20	$-$ 16.40	1.17
14.	40.80	46.20	+ 5.40	0.38
28.	98.30	93.20	$-$ 5.10	0.17
30.	83.80	99.80	+ 16.00	0.57

Considering the insecurity of the data, this representation is quite as good as could be expected, and proves the hypothesis that the errors of observation increase proportionally with the distance, to be substantially correct.

We may suppose that, in measuring the breadth of the tail, one source of the discrepancies from the normal breadth is to be ascribed to the uncertainty of the front edge, and another to the uncertainty of the rear edge. The mean values of these discrepancies we will represent by e and $e\sqrt{h'}$; h' having the significance explained above. Their sum will then be

$$c - o = e\sqrt{1 + h'};$$

hence from (4),

$$(5) \qquad e = \frac{0'.80 + 3'.30\ a}{\sqrt{1 + h'}}.$$

If the normal breadths have been derived from a sufficient number of observations, e will represent, very nearly, the arithmetical mean of errors arising from the ordinary difficulty of recognizing the front margin of the tail at a given distance, a, from the nucleus. The corresponding probable error, using the term in its technical sense, will be

$$0.8453 \times \frac{0'.80 + 3'.30\ a}{\sqrt{1 + h'}} = \pm \frac{0'.676 + 2'.789\ a}{\sqrt{1 + h'}}.$$

It is reasonable to suppose that the probable error of a determination of the absolute position of a point on the front edge will vary nearly in the same proportion as a function of the distance from the nucleus; it follows, then, that the factor g'', in the assumed expression for the weight of an observation, viz.

$$w = g \times g' \times g'' \times g''';$$

may be expressed by

$$(6) \qquad g'' = \left(\frac{0'.80 + 3'.30\ a_1}{0'.80 + 3'.30\ a}\right)^2 = \left(\frac{1 + 4.125\ a_1}{1 + 4.125\ a}\right)^2,$$

where a_1 is the value of a corresponding to the unit of g''.

In the table of values of log. g'', given below, $g'' = 1$ corresponds with a_1, derived from the relation

$$0.8453 \times \frac{0'.80 + 3'.30\ a_1}{\sqrt{1 + h'}} = \frac{1'}{\sqrt{1 + h'}};$$

or

$$a_1 = 0°.116.$$

Values of $log.\ g'' = \left(\frac{1 + 4.125\,a_1}{1 + 4.125\,a}\right)^2.$

a	$0'.80 + 3'.30\,a$	log. g''	a	$0'.80 + 3'.30\,a$	log. g''	a	$0'.80 + 3'.30\,a$	log. g''
0°.0	0'.80	0.338	3°.0	10'.70	8.087	32°.0	106'.40	6.092
0.1	1.13	0.040	4.0	14.00	7.854	33.0	109.70	6.065
0.2	1.46	9.817	5.0	17.30	7.670	34.0	113.00	6.040
0.3	1.79	9.640	6.0	20.60	7.518	35.0	116.30	6.015
0.4	2.12	9.493	7.0	23.90	7.389	36.0	119.60	5.990
0.5	2.45	9.368	8.0	27.20	7.277	37.0	122.90	5.967
0.6	2.78	9.258	9.0	30.50	7.177	38.0	126.20	5.944
0.7	3.11	9.160	10.0	33.80	7.088	39.0	129.50	5.921
0.8	3.44	9.073	11.0	37.10	7.007	40.0	132.80	5.900
0.9	3.77	8.993	12.0	40.40	6.933	41.0	136.10	5.878
1.0	4.10	8.920	13.0	43.70	6.865	42.0	139.40	5.857
1.1	4.43	8.853	14.0	47.00	6.802	43.0	142.70	5.837
1.2	4.76	8.791	15.0	50.30	6.743	44.0	146.00	5.817
1.3	5.09	8.732	16.0	53.60	6.688	45.0	149.30	5.798
1.4	5.42	8.678	17.0	56.90	6.636	46.0	152.60	5.779
1.5	5.75	8.627	18.0	60.20	6.587	47.0	155.90	5.760
1.6	6.08	8.578	19.0	63.50	6.540	48.0	159.20	5.742
1.7	6.41	8.532	20.0	66.80	6.496	49.0	162.50	5.724
1.8	6.74	8.489	21.0	70.10	6.454	50.0	165.80	5.707
1.9	7.07	8.447	22.0	73.40	6.415	51.0	169.10	5.690
2.0	7.40	8.407	23.0	76.70	6.376	52.0	172.40	5.673
2.1	7.73	8.370	24.0	80.00	6.340	53.0	175.70	5.656
2.2	8.06	8.333	25.0	83.30	6.305	54.0	179.00	5.640
2.3	8.39	8.298	26.0	86.60	6.271	55.0	182.30	5.624
2.4	8.72	8.265	27.0	89.90	6.238	56.0	185.60	5.609
2.5	9.05	8.233	28.0	93.20	6.207	57.0	188.90	5.593
2.6	9.38	8.202	29.0	96.50	6.177	58.0	192.20	5.578
2.7	9.71	8.171	30.0	99.80	6.147	59.0	195.50	5.564
2.8	10.04	8.142	31.0	103.10	6.119	60.0	198.80	5.549
2.9	10.37	8.114						

If the errors in the observed position of points in the tail were occasioned solely by the difficulty of recognizing its actual outlines, we might adopt the expression

(7) $$\pm\,\frac{0'.676 + 2'.789\,a}{\sqrt{1 + h'}}$$

for the probable error of an observation upon the front edge of the average weight.

The uncertainty in the definition of the rear edge being considerably greater than on the front, h' must be larger than 1. The value actually adopted is $h' = 3$. We have, then,

$$h' > 1, \qquad \frac{0'.676 + 2'.789\ a}{\sqrt{1 + h'}} < \frac{0'.478 + 1'.972\ a}{\sqrt{1}},$$

$$h' = 3, \qquad \text{"} \quad = \frac{0'.338 + 1'.395\ a}{\sqrt{1}}.$$

It is not unlikely that even the latter limit is considerably larger than the error to which the observations are necessarily exposed from the mere difficulty of estimating the precise line defining the margin of the tail, since it is quite evident that the estimates of the breadths have not ordinarily been made with all the exactness of which they were susceptible.

We have now to consider the change in the probable error from day to day, which the gradual expansion of the tail, and especially its diffusion after the perihelion passage, would naturally lead us to expect. A comparison of each point observed upon the front edge of the tail with the concluded curve, will furnish the best means of investigating this question, and of ascertaining in general the extent of the errors to which the final results are liable.

From the manner in which the curve of the front edge has been constructed, it will be seen that the residual deviations obtained by comparing it with points projected from the observations do not represent the actual errors of the observations.

A series of points was projected, each representing a point in the required outline, yet, owing to the error of its position, not necessarily lying in it. Among these points a curve was drawn, giving to the whole as favorable a representation as was possible without admitting abrupt changes at variance with its assumed character. If the curve had been drawn so as to pass through each point, it would have been still inexact, and, indeed, usually most in error at the very points where it represented the observations exactly, although the residual errors would have entirely disappeared; these latter would gradually increase as the curve was made to approach its true position. Hence it is evident that the conditions to which the curve was made to conform, independently of individual observations, must be regarded in computing the probable errors from the residuals. One of the chief difficulties encountered will be to make proper allowance for the influence of the principle just alluded to, namely, the exclusion of abrupt flexures in the general direction of the curve, so as to preserve a regular sweep in the general contour.

We will suppose the number of points upon the front edge, derived from observation on a given date, to be denoted by N, and that n of these would be sufficient to determine the curve, provided they were free from error.

Let E be the distance of any one of the points from the concluded curve, and w the weight assigned to the observation by which it has been determined. If the curve has been drawn so as to afford the most favorable representation of all the observations according to the method of least squares, the probable distance of a projected point, having the unit of weight, from the true curve, will be

$$\text{Probable deviation} = 0.6745 \sqrt{\frac{\Sigma \, . \, w E^2}{N - n}} \, .$$

This, however, requires modification in two particulars, in order to answer to the process by which the curve of the front edge has been actually constructed. By referring to the account given of the method of construction, it will be seen that the position of the nucleus, together with the breadth and initial direction of the outlines of the tail near its origin, has been derived from independent sources. This is practically equivalent to the introduction of two points in the curve, unaffected by sensible errors; moreover, the curve finally adopted on any one date does not depend altogether upon observations made on that date, but, by the method of reduction, it gains somewhat in precision by results interpolated from the dates immediately preceding and following.

Not to neglect the influence of these conditions upon the residual errors, we may use the formula

$$\eta = 0.6745 \sqrt{\frac{\Sigma \, . \, w E^2}{N - H (n - n')}}$$

for the probable distance from the true curve of a point derived from an observation having the unit of weight; n' denoting the number of points definitely fixed, and $1 : H$, the proportion in which the weight of the curve derived from all the observations upon any one date is increased by including with it the results interpolated from adjacent dates.

Although the method of constructing the curves is scarcely susceptible of precise mathematical statement, it has yet an analogy with the following illustration, sufficient at least to justify the adoption of the expression used for η.

We will suppose the form of the equation of the curve to be known, and that it is proposed, by giving suitable values to its n constants, to satisfy a group consisting of N projected points, so that the sum of the squares of the residual deviations, multiplied by their respective weights, shall be a minimum.

If a provisional curve be drawn, differing from the above only in the constants of its equation, and nearly representing the observations, the conditional equations for determining the small corrections $a, b \, . \, . \, . \, . \, .$ to be applied to its constants, will be

$$(1)\qquad \begin{aligned} A_1 a + B_1 b + \ldots\ldots + M_1 &= e_1 \\ A_2 a + B_2 b + \ldots\ldots + M_2 &= e_2 \\ \ldots\ldots\ldots \end{aligned}$$

in which $A_1, B_1 \ldots\ldots$ are known numerical coefficients, $M_1, M_2 \ldots\ldots$ the deviations of the points from the provisional curve, and $e_1, e_2 \ldots\ldots$ their deviations from the true curve.

If $a', b' \ldots\ldots$ are the concluded values of $a, b \ldots\ldots$, and $a' + \alpha, b' + \beta \ldots\ldots$ their true values, substituting in (1)

$$(2)\qquad \begin{aligned} a &= a' + \alpha \\ b &= b' + \beta \\ &\ldots\ldots \end{aligned}$$

we have

$$(3)\qquad \begin{aligned} e_1 &= E_1 + A_1 \alpha + B_1 \beta + \ldots\ldots \\ e_2 &= E_2 + A_2 \alpha + B_2 \beta + \ldots\ldots \\ &\ldots\ldots\ldots \end{aligned}$$

where $E_1, E_2 \ldots\ldots$ are the residual errors obtained by comparing the concluded curve with the observations. Taking the squares of $e_1, e_2 \ldots\ldots$, and multiplying each by its respective weight $w_1, w_2 \ldots\ldots$, we have

$$(4)\qquad \Sigma . w e^2 = \Sigma . w E^2 + \alpha^2 \Sigma . w A^2 + \beta^2 \Sigma . w B^2 + \ldots\ldots + 2K,$$

in which

$$(5)\qquad \begin{aligned} K = \alpha \Sigma . w A E &+ \alpha\beta \Sigma . w A B + \beta\gamma \Sigma . w B C + \ldots\ldots \\ &+ \beta \Sigma . w B E + \alpha\gamma \Sigma . w A C + \ldots\ldots \\ &+ \gamma \Sigma . w C E + \ldots\ldots \\ &+ \ldots\ldots \end{aligned}$$

When the values $a', b' \ldots\ldots$ have been obtained by the method of least squares, the first column of terms in K disappears, since by that method

$$\Sigma . w A E = 0, \qquad \Sigma . w B E = 0, \qquad \ldots\ldots$$

The number of its remaining terms is

$$\frac{n\,(n-1)}{2},$$

n being the number of indeterminates in the conditional equations (1), which is the same as the number of constants in the equation of the curve. The terms are also similar in form, and mutually independent as to their signs.

If we make

$$(6)\qquad \Theta = \alpha^2 \Sigma . w A^2 + \beta^2 \Sigma . w B^2 + \ldots\ldots$$

(4) becomes

$$\Sigma . w e^2 = \Sigma . w E^2 + \Theta \left(1 + \frac{2K}{\Theta}\right).$$

To find the limit towards which $\frac{2K}{\Theta}$ approaches as N increases, we may use for K its mean value,

$$K_0 = \Theta \sqrt{\frac{n-1}{2Nn}}, \tag{7}$$

found by substituting in (5) the mean values of the products α, β . . . . . $w\,A\,B$ . . . . ., assuming all values of α_1, β_1 . . . . . to recur with equal frequency; in which case, by taking the arithmetical mean of all the terms, disregarding signs, the general value of one of the terms becomes

$$\frac{\Theta}{n\sqrt{N}},$$

and the sum of all the terms, their number being $\frac{n(n-1)}{2}$, is

$$K_0 = \frac{\Theta}{n\sqrt{N}} \sqrt{\frac{n(n-1)}{2}} = \Theta \sqrt{\frac{n-1}{2Nn}};$$

hence we have for the limit,

$$\frac{2K}{\Theta} = \sqrt{\frac{2(n-1)}{Nn}},$$

and

$$\Sigma \,.\, w e^2 = \Sigma \,.\, w E^2 + \Theta\left(1 \pm \sqrt{\frac{2(n-1)}{Nn}}\right), \tag{8}$$

in which the coefficient of Θ approaches unity as N increases.

To obtain the mean value of Θ, we notice that, in forming, by the method of least squares, the final equations for a' b' . . . . . in the order of the letters, the coefficient of a' in the first equation, of b' in the second, and so on, are respectively $\Sigma \,.\, w A^2$, $\Sigma \,.\, w B^2$ . . . . ., and the probable errors of the assumed values of the second numbers, viz.

$$\Sigma \,.\, w A E = 0, \qquad \Sigma \,.\, w B E = 0, \qquad . \; . \; . \; . \; .$$

are respectively

$$\eta \sqrt{\Sigma \,.\, w A^2}, \qquad \eta \sqrt{\Sigma \,.\, w B^2}, \qquad . \; . \; . \; . \; .$$

where η is the probable error of an original equation having a weight of unity. As N increases, the probable values of α, β . . . . . will therefore approach the limits

$$\alpha = \frac{\eta}{\sqrt{\Sigma \,.\, w A^2}}, \qquad \beta = \frac{\eta}{\sqrt{\Sigma \,.\, w B^2}}, \qquad . \; . \; . \; . \; .$$

Hence, when N is large, we have from (6) the probable value

$$\Theta = n\,\lambda^2,$$

from which we obtain, for its mean value,

$$\Theta = \frac{n}{N} \Sigma . w e^2. \tag{9}$$

Substituting this in (8) we find

$$\Sigma . w e^2 = \frac{N}{N - n} \Sigma . w E^2. \tag{10}$$

If, however, the values a', b' . . . . ., used to find $\Sigma . w E^2$, depend partly on other data not included in the original equations (1); and if, on this account, the mean values of α^2, β^2 . . . . . are less than they otherwise would have been in the proportion $H : 1$, we must then, in finding Θ, use, instead of (9), the value

$$\Theta = \frac{n}{N} H \Sigma . w e^2,$$

and (10) will become

$$\Sigma . w e^2 = \frac{N}{N - H n} \Sigma . w e^2, \tag{11}$$

giving for the probable error of an original equation of the unit of weight

$$\eta = 0.6745 \sqrt{\frac{\Sigma . w E^2}{N - H n}}.$$

When a number, n', of the projected points are known *a priori*, they will serve to eliminate as many indeterminates from the original equation; hence η will have the value

$$\eta = 0.6745 \sqrt{\frac{\Sigma . w E^2}{N - n + n'}}. \tag{12}$$

Finally, if both of these conditions have place at the same time, then

$$\eta = 0.6745 \sqrt{\frac{\Sigma . w E^2}{N - H (n - n')}}. \tag{13}$$

No precise rules can be laid down for giving values to H, n, and n'; the following considerations, however, applied to the particular circumstances of each case, will serve as a guide in deciding the choice, so that it may not be entirely arbitrary.

1.) The change in the general character of the curve from night to night may be assumed to be small and continuous; so that there will be no difficulty in ascertaining approximately the relative weight of an interpolated curve upon any given date. This condition will be sufficient to determine the value of H nearly enough for the object required.

2.) To decide upon the number of constants in the equation of the curve, we

may estimate the number of points lying in the front edge of the tail, and favorably distributed in position, which would be required in order to construct it graphically, without introducing sensible errors in supplying the intermediate arcs; n may then be made equal to the least number of points which will suffice for this purpose. If, for instance, the curve is assumed to be the arc of a circle, we should have $n = 3$; for a well-recognized departure from uniform curvature, we should use $n = 4$, and higher numbers to express other characteristics.

3.) The position of the nucleus, together with the form of the head of the Comet, and the direction of the initial axis of the tail, have been furnished from sources independent of the rest of the data. For the present purpose they may be regarded as equivalent to a sensibly exact determination of two points in the curve, corresponding to the value $n' = 2$.

The relative weight of an interpolated or extrapolated front edge may be found as follows: —

Let it be supposed that a point, p, on the true front edge, projected upon the Chart, takes, at the successive epochs $t = 0$, $t = 1$, $t = 2$ . . . . . the positions p_0, p_1 . . . . ., and let these points be connected by a continuous curve representing the path of p. The arcs measuring its motion during the intervals $t = 0$, $t = 1$, $t = 2$ . . . . . reckoned from p_0, we will call $S_0 + s_0$, $S_1 + s_1$ . . . . ., where s_0, s_1 . . . . . are the errors of the concluded values S_0, S_1 . . . . .

The interpolated or extrapolated values of S_3 under different circumstances, for equidistant values of t will be as follows: —

Interpolation.	Extrapolation.
If 2d Diff. are insensible $S_3 = \frac{1}{2}(S_2 + S_4)$.	If 2d Diff. are insensible $S_3 = -S_1 + 2S_2$.
" 3d " " $S_3 = \frac{1}{3}(-S_1 + 3S_2 + S_4)$.	If 3d " " " $S_3 = S_0 - 3S_1 + 3S_2$.
" 3d " " $S_3 = \frac{1}{6}(-S_1 + 4S_2 + 4S_4 - S_5)$.	

From these, the errors of S_3 will be found by substituting s_0, s_1 . . . . . for S_0, S_1 . . . . . When the probable value of S_3 has been thus ascertained, we may obtain from it the weight of S_3, and thence, by the definition of H,

$$\frac{1}{H} = \frac{\text{weight of observed } S_3 + \text{weight of interpolated } S_3}{\text{weight of observed } S_3}.$$

For instance, if the probable errors of the observed values of S_0, S_1 . . . . . were each equal to s_1, we should have

$$\frac{1}{H} = 1 + \frac{s^2}{s_3^2};$$

and from the above expressions

$$s_3 = \frac{s}{\sqrt{2}}, \quad H = \frac{1}{3}, \qquad s_3 = s\sqrt{5}, \quad H = \frac{5}{6},$$

$$s_3 = \frac{s}{3}\sqrt{11}, \quad H = \frac{11}{20}, \qquad s_3 = s\sqrt{19}, \quad H = \frac{19}{20},$$

$$s_3 = \frac{s}{6}\sqrt{34}, \quad H = \frac{34}{70}.$$

The following are the numbers which have been used for N, H, $n - n'$, etc.

Values of H, N, and $n - n'$.

1858.	$H =$	$N =$	$n - n' =$	$N - H(n - n') =$	$H(n - n')$
Sept. 26	0.68	9	2	7.64	1.36
27	0.37	16	2	15.26	0.74
28	0.58	18	3	16.26	1.74
29	0.41	9	3	7.77	1.23
30	0.66	37	4	34.36	2.64
Oct. 1	0.38	12	4	10.48	1.52
2	0.58	26	4	23.68	2.32
3	0.46	24	4	22.16	1.84
4	0.40	26	4	24.40	1.60
5	0.63	37	4	34.48	2.52
6	0.70	20	4	17.20	2.80
7	0.16	14	4	13.36	0.64
8	0.79	41	4	37.84	3.16
9	0.53	25	4	22.88	2.12
10	0.67	14	4	11.32	2.68
11	0.22	8	3	7.34	0.66
12	0.67	13	3	10.99	2.01
13	0.65	10	3	8.05	1.95
14	0.41	3	2	2.18	0.82
15	0.65	4	2	2.70	1.30
16	0.30	1	1	0.70	0.30
17	0.92	2	1	1.08	0.92

In N is included the whole number of observations on a given date, whether made directly upon the front edge, or reduced to it from the axis and rear edge. The value $n' = 2$ has been used throughout.

The arcs measured from the points projected from the original observations to the nearest points in the chart outlines of the tail, have furnished the numbers exhibited in the subjoined tables. A positive sign prefixed to $E = c - o$ indicates that the normal curve is in advance of the observation. The coefficients

g and g', log $\frac{w}{g'''}$ = log. $(g \times g' \times g'')$, and $\frac{w}{g'''}$ $(c - o)^2$ for the front outline, $\frac{h''}{g'''}$ $w\,(c - o)^2$ for the axis, and $\frac{h'}{g'''}$ $w\,(c - o)^2$ for the rear outline, are also given.

The weight of an observed point on the front edge has, as above, the form

$$w = g \times g' \times g'' \times g''',$$

where g, g' . . . . . have the signification explained in the foregoing pages.

Comparison of Observed Points in the Front Edge of the Tail with the Normal Curves. Plates XXV. and XXVI.

Date. 1858.	Place of Observation.	Distance from Nucleus.	$c - o$	$g \times g'$	log. $\frac{w}{g'''}$	$\frac{w\,(c-o)^2}{g'''}$	$\Sigma \frac{w\,(c-o)^2}{g'''}$
Sept. 26	Poulkova	2°	+0° 3′	3×1	8.885	0.69	
	Poulkova	4	+0 7	3×1	8.331	1.05	
	Poulkova	6	+0 6	3×1	7.995	0.36	
	Oporto	8	—0 15	2×1	7.578	0.85	2.95
Sept. 27	Obs. of Harvard College . .	2	—0 9	1×⅗	8.186	1.24	
	Obs. of Harvard College . .	3	—0 13	1×⅗	7.865	1.24	
	Obs. of Harvard College . .	7	—0 8	2×⅗	7.468	0.19	
	Obs. of Harvard College . .	12	—0 25	3×1	7.410	1.61	4.28
Sept. 28	Altona	3	—0 3	3×⅔	8.388	0.22	
	Altona	5	—0 8	3×⅔	7.971	0.60	
	Altona	7	—0 5	3×1	7.866	0.18	
	Altona	7	0 0	3×⅔	7.690	0.00	
	Altona	9	+0 3	3×⅔	7.478	0.03	
	Altona	11	+0 1	3×⅔	7.308	0.00	
	Altona	13	+0 4	3×⅔	7.166	0.02	
	Altona	14	+0 45	3×1	7.279	3.85	
	Altona	15	+0 13	3×⅔	7.044	0.19	5.09
Sept. 29	Poulkova	3	—0 4	2×1	8.388	0.39	
	Poulkova	5	—0 3	2×1	7.971	0.08	
	Poulkova	7	—0 6	2×1	7.690	0.18	
	Vienna	8	+0 4	3×1	7.754	0.09	
	Vienna	9	—0 8	2×1	7.478	0.19	0.93
Sept. 30	Poulkova	0.2	0 0	2×1	0.118	0.00	
	Poulkova	0.4	+0 1	2×1	9.794	0.62	
	Poulkova	0.6	+0 2	2×1	9.559	1.45	
	Poulkova	2	+0 5	2×1	8.709	1.28	
	Poulkova	3	+0 7	2×1	8.388	1.20	
	Obs. of Harvard College . .	4	+0 5	3×1	8.331	0.54	
	Poulkova	4	+0 7	3×1	8.331	1.05	
	Poulkova	5	+0 9	2×1	7.971	0.76	
	Obs. of Harvard College . .	5	+0 5	3×⅔	7.971	0.23	
	Poulkova	6	+0 9	3×1	7.995	0.80	
	Poulkova	7	+0 13	2×1	7.690	0.83	
	Poulkova	8	+0 11	3×1	7.754	0.69	
	Poulkova	8	+0 8	2×1	7.578	0.24	
	Obs. of Harvard College . .	9	+0 9	3×1	7.654	0.36	
	Poulkova	10	+0 12	3×1	7.565	0.53	
	Poulkova	11	+0 14	2×1	7.308	0.40	

Comparison of Observed Points in the Front Edge with the Normal Curves. (*Continued.*)

Date. 1858.	Place of Observation.	Distance from Nucleus.	$c-o$	$g \times g'$	log. $\frac{w}{g'''}$	$\frac{w(c-o)^2}{g''}$	$\Sigma \frac{w(c-o)^2}{g'''}$
Sept. 30	Poulkova	12°	+0° 8′	3×1	7.410	0.16	
	Poulkova	14	+0 5	3×1	7.279	0.05	
	Poulkova	14	+0 35	2×1	7.103	1.55	
	Poulkova	16	0 0	3×1	7.165	0.00	
	Obs. of Harvard College . .	16	0 0	3×1	7.165	0.00	
	Obs. of Harvard College . .	21	—0 13	4×1	7.056	0.19	
	Obs. of Harvard College . .	24	—0 27	4×1	6.942	0.64	13.57
Oct. 1	Altona	5	+0 7	3×⅔	7.971	0.46	
	Altona	7	+0 18	3×⅔	7.690	1.58	
	Altona	10	0 0	3×⅔	7.389	0.00	
	Altona	10	+0 8	3×1	7.565	0.24	
	Altona	13	—0 10	3×1	7.342	0.22	
	Oporto	17	—0 17	3×1	7.113	0.37	
	Altona	19	—0 36	3×1	7.017	1.35	
	Altona	22	+0 13	3×1	6.892	0.13	
	Altona	24	—0 45	3×1	6.817	1.33	
	Altona	26	—0 26	3×1	6.748	0.38	6.06
Oct. 2	Vienna	1	+0 4	2×1	9.221	2.66	
	Obs. of Harvard College . .	2	0 0	2×½	8.408	0.00	
	Albany	3	+0 4	3×1	8.564	0.59	
	Obs. of Harvard College . .	3	—0 7	2×½	8.087	0.60	
	Obs. of Harvard College . .	3	—0 5	2×½	8.087	0.31	
	Vienna	4	+0 12	2×1	8.155	2.06	
	Albany	5	—0 4	3×1	8.147	0.22	
	Obs. of Harvard College . .	6	—0 12	2×½	7.518	0.47	
	Obs. of Harvard College . .	7	—0 19	2×½	7.389	0.89	
	Albany	9	—0 5	3×1	7.654	0.11	
	Obs. of Harvard College . .	9	+0 31	3×1	7.654	4.33	
	Obs. of Harvard College . .	11	—0 36	2×½	7.007	1.32	
	Altona	13	+0 31	3×1	7.342	2.11	
	Obs. of Harvard College . .	13	—0 43	2×⅔	6.989	1.80	
	Albany	14	+0 8	3×1	7.279	0.12	
	Obs. of Harvard College . .	15	—0 41	2×⅔	6.868	1.24	
	Obs. of Harvard College . .	18	—0 43	2×⅔	6.712	0.95	
	Obs. of Harvard College . .	18	—1 14	3×⅔	6.888	4.23	
	Albany	20	—0 9	3×1	6.973	0.08	
	Obs. of Harvard College . .	22	—0 41	2×1	6.716	0.88	
	Obs. of Harvard College . .	22	+0 4	3×1	6.892	0.01	
	Obs. of Harvard College . .	23	+1 14	3×1	6.853	3.90	
	Altona	23	+0 57	3×1	6.853	2.32	
	Obs. of Harvard College . .	30	+0 6	3×1	6.625	0.02	31.22
Oct. 3	Vienna	0.4	—0 5	2×1	9.794	15.56	
	Vienna	0.8	—0 5	2×1	9.374	5.91	
	Vienna	1.0	+0 1	2×1	9.221	0.17	
	Vienna	1.6	—0 2	2×1	8.879	0.30	
	Vienna	2.3	+0 2	2×1	8.599	0.16	
	Meadville	3	—0 5	2×½	8.087	0.31	
	Vienna	3	+0 2	2×1	8.388	0.10	
	Vienna	4	+0 5	3×1	8.331	0.54	
	Vienna	5	+0 8	3×1	8.147	0.90	
	Meadville	6	—0 9	2×½	7.518	0.27	
	Vienna	6	+0 10	2×1	7.819	0.66	

Comparison of Observed Points in the Front Edge with the Normal Curves. (*Continued.*)

Date. 1858.	Place of Observation.	Distance from Nucleus.	$c-o$	$g \times g'$	$\log. \frac{w}{g'''}$	$\frac{w(c-o)^2}{g'''}$	$\Sigma \frac{w(c-o)^2}{g'''}$
Oct. 3	Vienna	7°	+0° 12′	2×1	7.690	0.70	
	Vienna	8	+0 16	2×1	7.578	0.97	
	Meadville	9	—0 16	2×½	7.177	0.38	
	Meadville	13	—0 12	2×½	6.865	0.11	
	Meadville	18	—0 14	2×½	6.587	0.08	
	Meadville	21	—0 20	2×½	6.454	0.11	
	Breslau	24	—0 22	3×1	6.817	0.32	
	Breslau	24	+0 2	3×1	6.817	0.00	
	Vienna	25	+1 31	3×1	6.782	5.01	32.56
Oct. 4	Vienna	0.3	+0 2	2×1	9.941	3.49	
	Vienna	0.5	+0 2	2×1	9.669	1.87	
	Vienna	0.8	+0 3	2×1	9.374	2.13	
	Vienna	1.4	+0 7	2×1	8.979	4.66	
	Vienna	2	+0 10	2×1	8.709	5.12	
	Vienna	3	+0 12	2×1	8.388	3.52	
	Vienna	3	+0 16	2×1	8.388	6.25	
	Vienna	4	+0 12	2×1	8.155	2.06	
	Vienna	5	+0 9	2×1	7.971	0.76	
	Vienna	14	+1 13	3×1	7.279	10.11	
	Altona	15	—0 22	3×1	7.220	0.80	
	Breslau	21	—0 6	3×1	6.931	0.03	
	Altona	25	—0 2	3×1	6.782	0.00	
	Münster	29	+1 40	2×1	6.478	3.00	
	Vienna	30	—0 48	3×1	6.625	0.97	
	Markree	31	—0 32	1×1	6.119	0.13	
	Obs. of Harvard College . .	37	—1 35	1×1	5.967	0.88	45.78
Oct. 5	Haddenham	0.5	0 0	2×⅔	9.493	0.00	
	Haddenham	1.1	+0 3	2×⅔	8.978	0.86	
	Haddenham	1.3	+0 2	2×⅔	8.857	0.29	
	Haddenham	1.5	+0 4	2×⅔	8.752	0.90	
	Haddenham	1.7	+0 4	2×⅔	8.657	0.73	
	Haddenham	2.2	+0 5	2×⅔	8.458	0.72	
	Albany	5	+0 19	3×1	8.147	5.07	
	Münster	7	—0 40	3×1	7.866	11.75	
	Geneva	11	+0 45	2×1	7.308	4.11	
	Worcester	11	+0 6	2×1	7.308	0.07	
	Altona	11	—0 8	3×⅔	7.308	0.13	
	Albany	11	+0 24	3×1	7.484	1.75	
	Breslau	12	+0 13	4×1	7.535	0.58	
	Münster	12	—0 2	3×1	7.410	0.01	
	Oporto	12	—1 0	3×1	7.410	9.23	
	Altona	17	—0 6	3×1	7.113	0.05	
	Geneva	19	+2 0	2×1	6.841	9.98	
	Münster	20	+0 37	3×1	6.973	1.29	
	Altona	20	—0 8	3×⅔	6.797	0.04	
	Worcester	21	+1 9	2×1	6.755	2.71	
	Albany	22	—0 6	3×1	6.892	0.03	
	Altona	28	—0 10	3×⅔	6.508	0.03	
	Cranford	28	—1 2	2×1	6.508	1.24	
	Münster	31	+0 13	3×1	6.596	0.07	
	Altona	31	+0 3	3×1	6.596	0.00	
	Geneva	32	+2 22	2×1	6.393	4.98	
	Haddenham	33	+2 2	1×1	6.066	1.73	

Comparison of Observed Points in the Front Edge with the Normal Curves. (*Continued.*)

Date. 1858.	Place of Observation.	Distance from Nucleus.	$c-o$	$g\times g'$	log. $\frac{w}{g'''}$	$\frac{w\,(c-o)^2}{g''}$	$\Sigma\frac{w\,(c-o)^2}{g'''}$
Oct. 5	Cranford	33°	+1° 2′	2×1	6.367	0.89	
	Vienna	33	+0 57	3×1	6.543	1.14	
	Altona	33	+0 10	3×⅔	6.367	0.02	
	Obs. of Harvard College . .	40	+3 28	2×1	6.201	6.87	
	Geneva	40	—1 7	2×1	6.201	0.75	
	Dorpat	45	—3 11	2×1	6.099	4.58	72.60
Oct. 6	Münster	3	—0 2	3×⅗	8.342	0.09	
	Münster	6	—0 30	3×⅗	7.773	5.34	
	Albany	10	+0 34	3×1	7.565	4.25	
	Vienna	12	+1 57	2×1	7.234	23.46	
	Breslau	12	+0 11	4×1	7.535	0.41	
	Münster	12	+0 8	3×1	7.410	0.16	
	Obs. of Harvard College . .	12	—0 42	3×1	7.410	4.53	
	Obs. of Harvard College . .	13	—0 5	3×1	7.342	0.06	
	Altona	14	—0 38	3×1	7.279	2.75	
	Münster	20	+0 2	3×⅗	6.751	0.00	
	Albany	21	+0 11	3×1	6.931	0.10	
	Breslau	24	—0 3	4×1	6.942	0.01	
	Vienna	25	+0 45	2×1	6.606	0.81	
	Münster	26	+0 13	3×⅗	6.613	0.07	
	Altona	32	—0 1	3×1	6.569	0.00	
	Vienna	32	—0 12	2×1	6.393	0.04	
	Münster	36	—1 48	3×⅗	6.332	2.50	
	Obs. of Harvard College . .	49	+1 0	2×1	6.025	0.38	44.96
Oct. 7	Vienna	0.5	—0 2	2×1	9.669	1.87	
	Vienna	1	+0 2	2×1	9.221	0.66	
	Vienna	2	+0 13	2×1	8.708	8.63	
	Vienna	3	+0 13	2×1	8.388	4.13	
	Vienna	20	—0 38	3×1	6.973	1.35	
	Markree	20	—0 22	3×1	6.973	0.46	
	Heis	21	0 0	3×1	6.931	0.00	
	Vienna	26	+0 19	3×1	6.748	0.20	
	Poulkova	30	—1 2	3×1	6.624	1.61	
	Poulkova	44	—2 4	3×1	6.294	3.02	
	Lais	46	—2 29	3×1	6.256	6.34	28.27
Oct. 8	Obs. of Harvard College . .	0.5	+0 1	3×⅓	9.368	0.23	
	Obs. of Harvard College . .	1	0 0	3×⅓	8.920	0.00	
	Coll. Romano	2	—0 28	3×⅓	8.407	20.00	
	Obs. of Harvard College . .	2.5	—0 6	3×⅓	8.233	0.62	
	Coll. Romano	3.5	—0 34	3×⅓	7.970	11.00	
	Obs. of Harvard College . .	5	—0 23	3×⅓	7.670	2.47	
	Coll. Romano	5	—0 46	3×⅓	7.670	9.79	
	Coll. Romano	7	—0 59	3×⅓	7.389	8.52	
	Obs. of Harvard College . .	7	—0 30	3×⅓	7.389	2.20	
	Münster	7	+0 3	3×1	7.389	0.02	
	Obs. of Harvard College . .	9	—0 45	3×½	7.353	4.57	
	Coll. Romano	9	—1 6	3×½	7.353	9.78	
	Albany	9	+0 12	3×1	7.654	0.65	
	Obs. of Harvard College . .	10	—0 47	3×½	7.264	4.05	
	Coll. Romano	12	—1 9	3×½	7.109	6.13	
	Markree	12	+1 20	3×1	7.410	16.44	
	Albany	14	+0 10	3×1	7.279	0.19	

Comparison of Observed Points in the Front Edge with the Normal Curves. (*Continued.*)

Date. 1858.	Place of Observation.	Distance from Nucleus.	$c-o$	$g\times g'$	log. $\frac{w}{g'''}$	$\frac{w\,(c-o)^2}{g'''}$	$\Sigma\frac{w\,(c-o)^2}{g'''}$
Oct. 8	Münster	14°	—0° 24′	3×1	7.279	1.10	
	Obs. of Harvard College . .	14	—0 53	$3\times\frac{2}{3}$	7.103	3.56	
	Coll. Romano	14	—0 50	$3\times\frac{2}{3}$	7.103	3.17	
	Altona	18	—0 24	3×1	7.064	0.66	
	Coll. Romano	19	+0 13	3×1	7.017	0.17	
	Poulkova	19	—0 2	3×1	7.017	0.00	
	Vienna	19	+0 10	3×1	7.017	0.10	
	Tretire	19	+0 27	3×1	7.017	0.76	
	Breslau	20	—0 25	4×1	7.098	0.78	
	Markree	20	—0 1	3×1	6.993	0.00	
	Münster	20	—0 34	3×1	6.993	1.14	
	Obs. of Harvard College . .	20	—0 15	3×1	6.993	0.22	
	Coll. Romano	23	+2 10	$3\times\frac{2}{3}$	6.671	7.93	
	Coll. Romano	26	+4 20	$3\times\frac{2}{3}$	6.572	25.22	
	Vienna	29	+1 33	3×1	6.654	3.89	
	Obs. of Harvard College . .	29	+4 9	3×1	6.654	27.92	
	Münster	29	—1 18	3×1	6.655	2.74	
	Münster	32	—1 50	3×1	6.569	4.48	
	Vienna	32	+3 18	3×1	6.569	32.90	
	Poulkova	34	+3 0	3×1	6.517	10.64	
	Altona	35	+0 17	3×1	6.492	0.01	
	Markree	35	—0 15	3×1	6.492	0.01	
	Obs. of Harvard College . .	52	+3 9	1×1	5.673	1.69	225.75
Oct. 9	Poulkova	6	—0 42	$3\times\frac{2}{3}$	7.819	11.60	
	Albany	6	+0 36	3×1	7.995	12.80	
	Oporto	8	+1 10	2×1	7.578	18.50	
	Münster	8	—0 21	$3\times\frac{3}{5}$	7.619	1.83	
	Poulkova	11	—1 0	$3\times\frac{2}{3}$	7.308	7.30	
	Münster	13	—0 6	$3\times\frac{3}{5}$	7.207	0.06	
	Oporto	13	—0 17	2×1	7.166	0.00	
	Münster	16	—0 1	$3\times\frac{3}{5}$	7.030	0.00	
	Albany	16	+0 55	3×1	7.165	4.42	
	Poulkova	17	—0 45	$3\times\frac{2}{3}$	6.937	1.76	
	Dorpat	24	+0 55	3×1	6.817	1.99	
	Altona	24	+0 30	3×1	6.817	0.59	
	Albany	26	+1 10	3×1	6.748	2.73	
	Münster	26	+1 13	$3\times\frac{3}{5}$	6.613	1.74	
	Poulkova	26	+0 8	$3\times\frac{2}{3}$	6.572	0.02	
	Altona	27	—0 37	3×1	6.715	0.71	
	Münster	32	+2 2	$3\times\frac{3}{5}$	6.434	4.02	
	Poulkova	33	+0 26	$3\times\frac{1}{2}$	6.241	0.12	
	Altona	33	—1 10	$3\times\frac{2}{3}$	6.366	1.14	
	Poulkova	41	—0 19	$3\times\frac{1}{2}$	6.054	0.04	
	Altona	42	—1 12	$3\times\frac{2}{3}$	6.158	0.74	
	Altona	49	—0 29	3×1	6.201	0.13	
	Poulkova	49	—2 30	$3\times\frac{1}{2}$	5.900	1.79	
	Dorpat	53	+1 7	3×1	6.133	0.61	74.64
Oct. 10	Albany	1.6	+0 12	$3\times\frac{1}{2}$	8.754	8.17	
	Albany	7	+0 33	$3\times\frac{2}{3}$	7.690	5.35	
	Albany	8	+0 36	$3\times\frac{2}{3}$	7.578	4.90	
	Münster	8	+0 17	3×1	7.754	1.64	
	Albany	15	+0 35	$3\times\frac{2}{3}$	7.044	1.36	
	Altona	19	+0 27	3×1	7.017	0.76	

Comparison of Observed Points in the Front Edge with the Normal Curves. (*Concluded.*)

Date. 1858.	Place of Observation.	Distance from Nucleus.	$c-o$	$g \times g'$	log. $\frac{w}{g'''}$	$\frac{w(c-o)^2}{g'''}$	$\Sigma' \frac{w(c-o)^2}{g'''}$
Oct. 10	Münster	19°	+0° 15′	3×1	7.017	0.23	
	Albany.	19	+0 26	3×1	7.017	0.71	
	Albany.	23	+0 1	3×1	6.853	0.01	
	Albany.	25	—0 14	3×1	6.782	0.12	
	Mussoree	25	—0 42	2×1	6.606	0.71	
	Altona	26	+0 19	3×1	6.748	0.20	
	Münster	29	—0 12	3×1	6.654	0.06	24.22
Oct. 11	Münster	7	+0 11	3×1	7.866	0.89	
	Vienna.	7	+1 37	2×1	7.690	46.07	
	Münster	20	+0 13	3×1	6.973	0.16	
	Münster	31	+1 11	3×1	6.596	1.99	49.11
Oct. 12	Altona	2	—0 3	3×⅔	8.709	0.46	
	Altona	7	0 0	3×⅔	7.690	0.00	
	Münster	8	—1 41	1×⅗	7.055	11.58	
	Münster	12	—1 21	1×⅗	6.711	3.38	
	Altona	16	+0 3	3×1	7.165	0.01	
	Münster	23	—2 7	1×⅗	6.154	2.30	
	Altona	24	—0 13	3×1	6.817	0.11	
	Münster	29	—2 29	1×⅗	5.955	2.00	
	Dorpat	37	—0 4	3×1	6.444	0.00	
	Altona	37	—0 27	3×1	6.444	0.20	
	Münster	37	—2 19	1×⅗	5.745	1.07	
	Obs. of Harvard College . .	46	—1 20	1×	5.779	0.38	21.49
Oct. 13	Geneva	6	+1 1	2×1	7.819	24.50	
	Oporto	7	+0 13	3×1	7.866	1.24	
	Poulkova	7	+0 23	3×1	7.866	3.89	
	Geneva	23	+3 5	2×1	6.677	16.27	
	Geneva	28	+2 23	2×1	6.508	6.58	
	Poulkova	31	—1 59	3×1	6.596	5.57	
	Geneva	37	+0 30	2×1	6.268	0.17	
	Poulkova	45	+0 55	3×1	6.275	0.57	
	Poulkova	46	—1 4	3×1	6.256	0.73	59.52
Oct. 14	Oporto	2	+0 33	1×1	8.408	27.92	
	Oporto	7	+0 42	1×1	7.389	4.31	
	Dorpat	32	—1 41	2×1	6.393	2.52	34.75
Oct. 15	Albany.	3	+0 5	3×1	8.564	0.91	
	Breslau	9	—1 1	3×1	7.654	16.77	
	Albany.	19	—1 42	3×1	7.017	10.85	28.53
Oct. 16	Breslau	9	+1 3	3×1	7.654	17.88	17.88
Oct. 17	Melbourne	5	+0 3	3×1	8.147	0.13	
	Melbourne	10	+0 4	3×1	7.565	0.06	0.19

Comparison of Observed Points in the Axis of the Tail with the Normal Curves. Plates XXIV. and XXVI.

Date. 1858.	Place of Observation.	Distance from Nucleus.	$c - o$	$g \times g'$	log. $\frac{h''}{g'''} w$	$\frac{h''}{g'''} w (c-o)^2$	$\Sigma \frac{h''}{g'''} w (c-o)^2$
Sept. 26	Oporto	8°	—0° 5′	2×1	7.578	0.09	0.09
Sept. 27	Obs. of Harvard College .	3	—0 10	$2\times\frac{3}{4}$	8.263	1.83	
	Obs. of Harvard College .	4	+0 9	$1\times\frac{3}{4}$	7.729	0.43	
	Obs. of Harvard College .	5	—0 16	3×1	8.147	3.59	
	Obs. of Harvard College .	7	—0 32	$2\times\frac{3}{4}$	7.453	3.76	
	Obs. of Harvard College .	7	+0 35	$1\times\frac{3}{4}$	7.152	2.21	
	Obs. of Harvard College .	11	+0 58	$1\times\frac{3}{4}$	6.963	2.56	
	Obs. of Harvard College .	12	+1 15	$1\times\frac{3}{4}$	6.808	3.61	
	Obs. of Harvard College .	12	—1 22	$1\times\frac{3}{4}$	6.808	4.32	22.31
Sept. 28	Markree	7	+0 9	3×1	7.866	0.36	
	Altona	13	+0 34	$3\times\frac{2}{3}$	7.166	1.69	
	Altona	15	+0 41	$3\times\frac{2}{3}$	7.044	1.77	3.82
Sept. 30	Markree	12	+0 15	3×1	7.410	0.58	
	Markree	19	+0 17	2×1	6.841	0.20	0.78
Oct. 4	Markree	25	—1 41	3×1	6.782	0.20	
	Coll. Romano	25	—2 9	1×1	6.305	3.37	
	Oporto	23	—2 3	2×1	6.677	7.16	10.73
Oct. 5	Geneva	20	—0 13	2×1	6.797	0.11	0.11
Oct. 8	Coll. Romano	25	+3 39	3×1	6.782	28.90	28.90
Oct. 13	Poulkova	13	—0 2	3×1	7.342	0.20	0.20

Comparison of Observed Points in the Rear Edge of the Tail with the Normal Curves. Plates XXIV. and XXVI.

Date. 1858.	Place of Observation.	Distance from Nucleus.	$c - o$	$g \times g'$	log. $\frac{h'}{g'''} w$	$\frac{h'}{g'''} w (c-o)^2$	$\Sigma \frac{h'}{g'''} w (c-o)^2$
Sept. 26	Poulkova	1°.8	—0° 8′	3×1	8.966	5.90	
	Poulkova	4	+0 7	3×1	8.331	1.05	
	Poulkova	6	—0 3	3×1	7.995	0.09	
	Oporto	8	—0 30	2×1	7.578	3.40	10.44
Sept. 27	Obs. of Harvard College .	1.6	+0 19	$1\times\frac{3}{5}$	8.356	8.20	
	Obs. of Harvard College .	4	+0 26	$1\times\frac{3}{5}$	7.632	1.15	
	Obs. of Harvard College .	7	+0 37	$2\times\frac{3}{5}$	7.711	7.05	
	Obs. of Harvard College .	13	+0 19	$3\times\frac{3}{5}$	7.120	0.48	16.88
Sept. 28	Altona	2	+0 6	$3\times\frac{2}{3}$	8.708	0.18	
	Altona	4	+0 12	$3\times\frac{2}{3}$	8.155	2.05	
	Altona	7	+0 19	$3\times\frac{2}{3}$	7.690	1.77	
	Altona	11	+0 19	$3\times\frac{2}{3}$	7.308	0.74	
	Altona	13	+0 19	$3\times\frac{2}{3}$	7.166	0.11	
	Altona	15	+0 27	$3\times\frac{2}{3}$	7.044	0.00	4.85

Comparison of Observed Points in the Rear Edge with the Normal Curves. (*Concluded.*)

Date. 1858.	Place of Observation.	Distance from Nucleus.	$c-o$	$g \times g'$	log. $\frac{h'}{g'''} w$	$\frac{h'}{g'''} w (c-o)^2$	$\Sigma \frac{h'}{g'''} w (c-o)^2$
Sept. 29	Poulkova	2°.5	—0° 1′	3×1	8.710	0.05	
	Poulkova	4	—0 1	3×1	8.331	0.02	
	Poulkova	6	—0 10	3×1	7.995	0.98	
	Poulkova	8	—0 29	3×1	7.754	4.77	5.82
Sept. 30	Poulkova	0.1	0 0	2×1	0.341	0.00	
	Poulkova	0.3	—0 2	2×1	9.947	3.49	
	Poulkova	0.5	0 0	2×1	9.669	0.00	
	Poulkova	1	0 0	2×1	9.227	0.00	
	Poulkova	1.6	+0 7	2×1	8.928	4.15	
	Poulkova	2.8	+0 12	2×1	8.443	3.99	
	Poulkova	4	+0 10	3×1	8.331	2.14	
	Poulkova	5	+0 18	3×1	8.147	4.54	
	Poulkova	5	+0 10	3×1	8.147	1.40	
	Poulkova	7	+0 10	3×1	7.866	0.74	
	Poulkova	8	+0 11	3×1	7.754	0.69	
	Poulkova	10	+0 4	3×1	7.565	0.06	21.14
Oct. 1	Altona	13	+0 43	3×1	7.342	4.05	
	Oporto	16	—0 41	2×1	6.989	1.63	5.68
Oct. 2	Obs. of Harvard College .	12	+1 30	3×1	7.410	20.80	
	Altona	13	+0 56	3×1	7.342	6.91	27.71
Oct. 3	Vienna	0.3	—0 7	2×1	9.941	42.76	
	Vienna	1.4	—0 10	2×1	8.979	9.53	
	Vienna	2.0	—0 5	2×1	8.708	1.28	
	Vienna	2.6	—0 11	2×1	8.503	3.85	57.42
Oct. 4	Vienna	0.1	0 0	2×1	0.341	0.00	
	Vienna	0.4	+0 2	2×1	9.794	2.49	
	Vienna	0.6	+0 2	2×1	9.559	1.45	
	Vienna	1.2	+0 2	2×1	9.092	0.49	
	Vienna	1.6	+0 6	2×1	8.579	1.36	
	Altona	18	+1 35	3×1	7.064	10.50	16.29
Oct. 5	Altona	16	+1 25	3×1	7.165	10.56	
	Cranford	27	—2 31	2×1	6.539	21.73	
	Oxford	27	—2 37	2×1	6.539	22.86	55.15
Oct. 6	Breslau	13	+0 36	3×1	7.342	2.85	
	Altona	15	+1 25	3×1	7.220	11.90	14.75
Oct. 7	Vienna	6	—0 14	3×1	7.995	1.94	
	Münster	13	+1 04	3×1	7.342	8.95	
	Poulkova	27	—3 45	3×1	6.715	26.20	37.09
Oct. 9	Altona	13	—0 51	3×1	7.342	5.86	5.86
Oct. 10	Altona	14	—1 34	3×1	7.279	16.80	16.80
Oct. 11	Vienna	9	+0 39	3×1	7.654	6.90	
	Münster	9	+0 44	3×1	7.654	8.71	
	Vienna	17	+0 14	3×1	7.113	0.25	
	Münster	17	+0 14	3×1	7.113	0.25	16.11
Oct. 12	Altona	17	—2 10	3×1	7.113	22.00	22.00
Oct. 15	Oporto	7	—0 45	3×1	7.866	14.90	14.90

The numbers in the columns headed $\frac{w}{g'''}(c-o)^2$, $\frac{h'}{g'''}w(c-o)^2$, and $\frac{h''}{g''}w(c-o)^2$, after dividing the last two by $h'=3$ and $h''=2$ respectively, furnish the following values of

$$\frac{\eta^2}{g'''} = 0.6745^2 \frac{\Sigma \frac{w}{g''}(c-o)^2}{N-H(n-n')}.$$

Date. 1858.	$\frac{\eta^2}{g'''}$	Number of Observations.			Total Number.
		Front.	Axis.	Rear.	
Sept. 26	0.385	4	1	4	9
27	0.628	4	8	4	16
28	0.233	9	3	6	18
29	0.168	5	0	4	9
30	0.277	23	2	12	37
Oct. 1	0.274	10	0	2	12
2	0.777	24	0	2	26
3	1.061	20	0	4	24
4	1.109	17	3	6	26
5	1.201	33	1	3	37
6	1.319	18	0	2	20
7	1.383	11	0	3	14
8	2.888	40	1	0	41
9	1.523	24	0	1	25
10	1.198	13	0	1	14
11	3.377	4	0	4	8
12	1.193	12	0	1	13
13	3.368	9	1	0	10
14	7.251	3	0	0	3
15	5.645	3	0	1	4
16	11.619	1	0	0	1
17	0.080	2	0	0	2
		289	20	60	369

Since η represents the probable error corresponding to the unit of weight, and is supposed to be the same through the whole interval, it is evident, from the above numbers, that g''' is not constant.

By giving to each a weight proportional to $N-H(n-n')$, and combining them graphically, we obtain the following adopted values of $\frac{\eta}{\sqrt{g'''}}$.

1858. Sept. 26	$\frac{\eta}{\sqrt{g'''}} = 0.490$	1858. Oct. 1	$\frac{\eta}{\sqrt{g'''}} = 0.707$
27	0.505	2	0.787
28	0.538	3	0.872
29	0.583	4	0.961
30	0.640	5	1.060

1858. Oct.	6	$\frac{\eta}{\sqrt{g'''}} = 1.166$	1858. Oct.	12	$\frac{\eta}{\sqrt{g'''}} = 1.945$
	7	1.273		13	2.095
	8	1.386		14	2.254
	9	1.515		15	2.417
	10	1.650		16	2.572
	11	1.794		17	2.727

It may be noticed that an increase of $\frac{\eta}{\sqrt{g'''}}$ during September and the early part of October would naturally result from the greater diffusion in the outlines of the Comet as it approached the earth. Shortly after its time of nearest approach, the light of the moon and the atmospheric extinction began to have an injurious influence, and the tail was fast being dissipated. These conditions are quite sufficient to account for the continued increase in the errors of observation, which is plainly indicated in the values of $\frac{\eta}{\sqrt{g'''}}$, or rather in the values of g''', since η is constant.

To form an estimate of the probable error of a point in one of the normal front outlines for a given date and distance from the nucleus, we will suppose u to be the weight belonging to the determination of the point, and ε its probable error; or

$$\varepsilon = \frac{\eta}{\sqrt{u}}.$$

u must be proportional:—

1st. To the sum of all the products $\frac{g \times g'}{h}$ on the dates in question; h having the values $h = 1$, $h' = 3$, and $h'' = 2$, for observations upon the front edge, rear, and axis, respectively.

2d. To the factor g'', corresponding to the distance of the point from the nucleus.

3d. To the factor g''', corresponding to the date.

4th. To $\frac{1}{H}$, in order to include in u the increased value given to the concluded curve, from the combination of results interpolated from other dates, with those derived directly from observation, on the date for which ε is required.

5th. To $\frac{1}{n - n'}$; for we may, in a general way, describe the process of constructing the curve, so far as it depends upon observations made at a single date, as equivalent to satisfying, with the least residual errors, N conditional equations, having $(n - n')$ indeterminates. The weight of any one of the final equations resulting from their combination will, on the average, be equal to the sum of the weights of the original equations divided by the number of indeterminates $n - n'$. But since $n - n'$ known points on the curve would furnish as many equations,

we may consider each final equation as equivalent to one point given in position, and its error as the error of such a point; the weight of one of the $(n-n')$ final equations will represent the weight of a point on the curve resulting from their solution, and $\frac{1}{n-n'}$ should, therefore, be introduced as a factor in u. We shall then have

$$u = \frac{g'' \times g'''}{H(n-n')} \, \Sigma \, \frac{g \times g'}{h}, \text{ and } \varepsilon = \sqrt{\frac{H(n-n')}{g'' \Sigma \frac{g \times g'}{h}}} \cdot \frac{\eta}{\sqrt{g'''}} \cdot$$

The chief difficulty in applying this expression for ε is to give a proper value to $H(n-n')$. The same quantity enters also into the formula already used for η,

$$\eta = 0.6745 \sqrt{\frac{\Sigma (w E^2)}{N - H(n-n')}};$$

but there an erroneous value would have comparatively little effect, because N is usually large, and H always less than unity. ε, being directly proportional to $\sqrt{H(n-n')}$, is more affected by an error in its assumed value. In making $n' = 2$, we have supposed the outline of the tail close to the nucleus and the initial direction of the axis, derived from telescopic observations and transferred to the charts, to be sensibly free from error. In the present application, this hypothesis, which is equivalent to the elimination of two constants from the equation of the curve, is open to objection, since the errors of the adopted outlines of the head of the Comet do have a sensible although but a slight influence on the value of ε for points near the nucleus. Moreover, there are no means of deciding with any certainty upon the numbers to be attributed to n. The unequal distribution of the observations at different distances from the nucleus will also affect the errors of the curves. No more is therefore to be expected from the discussion than the means of forming some general idea of the character of the errors of the curves.

The following are the numbers representing the probable errors of the concluded curves of the front edge, derived from the expression

$$\varepsilon = \sqrt{\frac{H(n-n')}{g'' \, \Sigma \, \frac{g \times g'}{h}}} \cdot \frac{\eta}{\sqrt{g'''}}.$$

a is the distance from the nucleus, and ε the probable value of the least distance between the true front edge and the adopted curve. For the reasons stated, it is not unlikely that for small values of a, ε is too small.

Probable Errors of the Normal Front Edge of the Tail.

Date. 1858.	a	ε	Date. 1858.	a	ε	Date. 1858.	a	ε
Sept. 26	2°	± 0′.9	Oct. 2	2°	± 1′.0	Oct. 6	16°	±12′.7
	4	1.7		4	1.9		20	15.9
	6	2.5		6	2.9		24	19.0
	8	3.3		8	3.8		30	23.7
	10	4.1		10	4.7		38	30.0
				12	5.6		46	36.3
Sept. 27	2	0.8		16	7.5		54	42.7
	4	1.5		20	9.3			
	6	2.2		24	11.1	Oct. 7	2	1.1
	8	2.9		30	13.9		4	2.1
	10	3.6		38	17.6		6	3.1
	12	4.3					8	4.1
	16	5.8	Oct. 3	2	1.1		10	5.1
				4	2.2		12	6.3
Sept. 28	2	0.9		6	3.2		16	8.2
	4	1.6		8	4.2		20	10.2
	6	2.4		10	5.2		24	12.2
	8	3.1		12	6.3		30	15.2
	10	3.9		16	8.3		38	19.2
	12	4.6		20	10.3		46	23.2
	16	6.1		24	12.4		54	27.3
	20	7.6		30	15.5			
				38	19.5	Oct. 8	2	1.6
Sept. 29	2	1.0					4	3.0
	4	2.0	Oct. 4	2	1.1		6	4.5
	6	2.9		4	2.2		8	5.9
	8	3.8		6	3.2		10	7.3
	10	4.8		8	4.2		12	8.7
	12	5.7		10	5.2		16	11.6
	16	7.6		12	6.2		20	14.5
	20	9.4		16	8.3		24	17.3
	24	11.3		20	10.3		30	21.6
				24	12.3		38	27.3
Sept. 30	2	0.8		30	15.4		46	33.1
	4	1.4		38	19.5		54	38.8
	6	2.1						
	8	2.8	Oct. 5	2	1.2	Oct. 9	2	1.9
	10	3.4		4	2.3		4	3.5
	12	4.2		6	3.3		6	5.2
	16	5.5		8	4.4		8	6.9
	20	6.9		10	5.5		10	8.5
	24	8.3		12	6.5		12	10.2
	30	10.3		16	8.7		16	13.5
				20	10.8		20	16.9
Oct. 1	2	1.0		24	12.9		24	20.2
	4	1.9		30	16.1		30	25.2
	6	2.8		38	20.4		38	31.9
	8	3.7		46	24.7		46	38.5
	10	4.7					54	45.2
	12	5.6	Oct. 6	2	1.8		62	51.9
	16	7.4		4	3.3			
	20	9.2		6	4.9	Oct. 10	2	2.9
	24	11.0		8	6.5		4	5.4
	30	±13.7		10	8.0		6	8.0
				12	± 9.6		8	±10.6

Probable Errors of the Normal Front Edge of the Tail. (*Concluded.*)

Date. 1858.	a	ε	Date. 1858.	a	ε	Date. 1858.	a	ε
Oct. 10	10°	±13′.1	Oct. 12	8°	±13′.9	Oct. 14	10°	±29′.2
	12	15.7		10	17.2		12	34.9
	16	20.8		12	20.6		16	46.2
	20	26.0		16	27.3		20	57.6
	24	31.1		20	34.0		24	69.0
	30	38.8		24	40.7		30	86.1
	38	49.1		30	50.8		38	108.9
	46	59.3		38	64.2			
	54	69.6		46	77.6	Oct. 15	2	5.4
	62	79.8		54	91.1		4	10.3
							6	15.1
Oct. 11	2	2.3	Oct. 13	2	3.7		8	20.0
	4	4.5		4	7.0		10	24.8
	6	6.6		6	10.5		12	29.7
	8	8.7		8	13.6		16	39.4
	10	10.8		10	16.9		20	49.1
	12	12.9		12	20.2			
	16	17.1		16	26.8	Oct. 16	2	5.1
	20	21.3		20	33.4		4	9.6
	24	25.3		24	40.0		6	14.2
	30	31.8		30	49.9		8	18.7
	38	40.2		38	63.1		10	23.2
	46	48.6		46	76.2		12	27.8
	54	57.0		54	89.4			
	62	65.3				Oct. 17	2	6.7
			Oct. 14	2	6.4		4	12.6
Oct. 12	2	3.8		4	12.1		6	18.6
	4	7.1		6	17.8		8	24.6
	6	±10.5		8	±23.5		10	±30.5

V. ON THE DEFLECTION OF THE TAIL.

Many observers have remarked a peculiar disposition of the light of the upper part of the tail, during the interval between the 28th of September and the 12th of October. The well-marked outline and superior brightness which distinguished the contour of the front edge for the first 15° or 20° of its length, could not be traced much beyond the latter limit. Its character seemed here to be lost in the sudden dissipation of the material of the tail over a large expanse, to the right hand of the continuation of its original curve. This caused an abrupt change in the direction of the line of principal brightness, and gave to the whole upper region of the tail the appearance of being deflected backwards. Its general aspect was that of a confused and scattered mist, left behind, and, as it were, abandoned in space by the bright portion nearer the nucleus.

Although the phenomenon was exhibited over an area occupied only by the fainter nebulosity, so that in many instances it failed to attract the notice of observers, there is sufficient independent testimony to prove the reality of its existence, and to enable us to form a tolerably correct notion of the details of the figure assumed by the tail beyond the point of transition. The earliest allusion to it occurs in the following note by Pape, at Altona, Sept. 28:—

"Der Schweif hatte sich seit Septbr. 22 ausserordentlich entwickelt; jedoch war im Allgemeinen seine Erscheinung der frühern ähnlich, nur war die linke Seite weit mehr an ihrem oberen Ende zurückgebogen als früher."

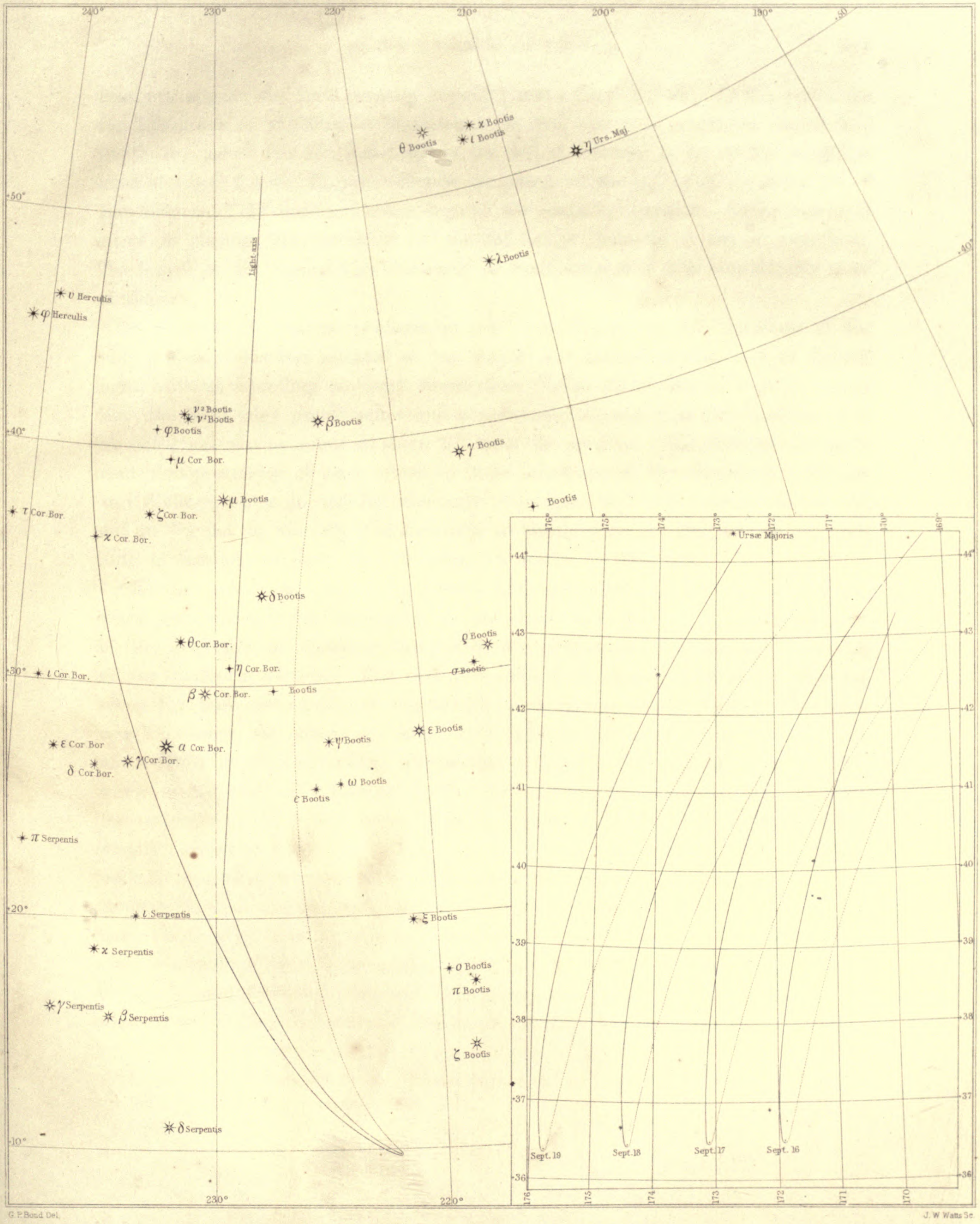
Again, on the 29th, Jeanjaquet, at Neuchatel, remarks:—

"La courbure de la queue, dans la partie haute du météore, me paraît mieux marquée que precédémment."

These passages, perhaps, scarcely amount to a distinct recognition of the phenomenon. The notices, and especially the sketches made on the 30th, at the Observatory of Harvard College are more explicit.

"It is curved . . . . . more suddenly at the extremity, so as to bring the direction below Mizar." The appearance at this date is well represented in Plate VIII., the faint light near the end of the tail, at a distance of about 20° from the nucleus, being slightly dispersed to the right hand of the continuation of the previous direction of curvature. In the Poulkova lithograph for this date,* this feature

* Pulk. Beob. des Grossen Cometen 1858, Tab. I.



COMET OF DONATI 1858.

OCTOBER 8TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE.

CHART OF DEFLECTION OF LIGHT-AXIS. CHART OF OUTLINES OF TAIL.

does not agree, the [illegible] tail [illegible] In this particular the [illegible] is [illegible] as [illegible] it is expressly stated that "with the naked eye the last traces of the tail [illegible] as far as the preceding bend of [illegible] and [illegible] Ursæ Majoris. Hence the length of [illegible] 26½°." The distance of [illegible] does not reach [illegible] agree in placing the extremity of [illegible] The length of 12° [illegible] recorded by Winnecke [illegible] of them [illegible]

On October [illegible] several [illegible] the [illegible] of the tail [illegible] light [illegible] that the front edge [illegible] its deflection was apparent at about [illegible] made independently of each other [illegible] and at Vienna on the 5th, it is [illegible] of October, we have the following [illegible]

"To the naked eye there was a [illegible] tail which gave [illegible] of the [illegible] of the [illegible] of the [illegible] when the tail [illegible] near its [illegible] tail [illegible] wards [illegible] the antecedent side, which [illegible] quently [illegible] tended towards a [illegible] point [illegible] distance from the [illegible] mate [illegible] point [illegible] Bottle [illegible] other branch [illegible] was that of

* G. Bond, [illegible]
† [illegible]
‡ [illegible]

does not appear, the light crossing beyond ζ and ε Ursæ Majoris. In this particular the lithograph is probably at fault, since in the text it is expressly stated that "with the naked eye the last trace of the tail is followed as far as the neighborhood of ε and ζ Ursæ Majoris. Hence the length of the tail would be about 25°."* The distance of 25° does not reach beyond the stars in question. Other observers agree in placing the extremity of the tail below them for a day or two later. The length of 19°, reported by Winnecke at Poulkova,† also falls considerably short of them.

On October 2d several accounts give η Ursæ Majoris as the terminus of the tail; probably this was selected as the bright star nearest to the limit of decided light, without intending an exact description. From other data, it is quite certain that the front edge passed below and considerably beyond it, in the direction of ζ; its deflection was apparent at about 21° from the nucleus. The sketches and notes made independently of each other by three observers at the Observatory of Harvard College, agree in making the front edge pass decidedly below η on the 2d, and at Vienna, on the 3d, it is described as reaching to it. On the 5th, 8th, and 10th of October, we have the following description by Webb:—

"To the naked eye there was a remarkable irregularity in the curve of the tail, which gave strongly the impression of the exhaustion, beyond a certain distance, of the projectile or repulsive force, and of a consequent diffusion and dispersion of the luminous material. This was first noticed on the evening of the transit,‡ when the train extended in a regular curve as far as σ and ρ Boötis, which were near its centre, but about one third of the distance between ρ and γ, where the tail attained its greatest width, the convexity began to be a little deflected backwards or flattened off. October 8, this was still more conspicuous; the curve of the antecedent side, which was carried regularly up to α Coronæ, being subsequently deflected from the direction of δ Draconis, to which it had previously tended, towards a fresh point between ι and ζ Draconis, about one third of their distance from the latter star, as far as could be ascertained in making an estimate of so very dim an object; sometimes I thought that ζ Draconis was the point indicated. The fainter branch could not be well made out higher than ψ Boötis; beyond this star it seemed, if anything, to approximate again towards the other branch; and the general impression of this side of the tail was that of

* O. Struve, Pulk. Beob. des Grossen Cometen 1858, p. 8.

† Pulk. Beob. des Grossen Cometen 1858, p. 32.

‡ October 5th.

spreading out like a feather, as compared with the more definite aspect of the convex edge. The whole length on this evening could not have been less than 45°; the greatest breadth, as measured by α Coronæ and ψ Boötis, about 7°. October 10, the curvature appeared regular as far as a line joining α Coronæ and ζ Herculis, or perhaps a little farther; thence a fainter ray of considerable breadth was deflected at a large angle, perhaps 60°, as far as the stars of Quadrans Muralis. This portion was very feeble, but certain, and looked quite like a scattered and abandoned vapor. Another observer agreed with me in suspecting that it was less bright at its connection with the regular tail than a little farther off." *

The proportion of the deflected region to the whole expanse of the tail increased rapidly from the 1st of October. Its appearance, especially after the head had set, while the upper part remained at a considerable altitude, was compared to that of smoke rising from a distant conflagration, driven off and dispersed before the wind. "Il semble qu'un grand vent la fouette et la force à s'incliner aussi vers le pôle."

The impressions received by others may be gathered from the following passages.

"In $\frac{1}{3}$ der Länge Entfernung vom Kerne verbreitet sich die Schweifmaterie in so auffallender Weise, gleichsam als könnten bei seiner schnellen Vorwärtsbewegung die entfernteren feinen Theilchen des Schweifes nicht schnell genug nachfolgen." †

"Si conserva pure all' osservatorio un disegno della cometa come era visibile ad occhio nudo, ove si ebbe cura di far rilevare la forma curva dell' estremità della coda, e quella specie di materia sparsa che l' accompagnava, irregolarmente diffusa che si potrebbe credere affatto uscita dalla sfera d' attrazione della cometa e perduta. Questa materia era sempre visibile dalla parte della curvatura interiore della coda la quale riusciva perciò mal terminata, mentre la esteriore era benissimo decisa; avuto riguardo alla sua posizione, resta assicurato che la parte più sfumata era dal lato che la cometa abbandonava col suo corso." ‡

"When closely scrutinized, the whole Comet had very much the appearance of a bird's wing." §

It is several times compared to a feather, or to a quill with the feathery fibres on one side stripped off, or shorter than on the other.

* Monthly Notices Royal Astr. Soc., Vol. XIX. pp. 23, 24.

† Astron. Nachrichten, 1169, pp. 263, 264.

‡ Mem. dell' Osserv. del Collegio Romano, 1859, p. 15.

§ Compare the outline from the Markree figure on Plate XXV(a).

"Die Krümmung des Bogens wird immer stärker und gegen das Ende breitete sich der Schweif auf seiner verwaschenen Seite federartig aus."

"The general impression of this side of the tail was that of spreading out like a feather."

"Die convexe Bogengestalt jedoch ist sehr regelmässig, durch ihre grosse Helligkeit bis an das Schweifende zu verfolgen, wodurch dieser Bogen, der in seiner Krümmung einen vollen Quadranten bildet, mit dem Kiel einer Feder zu vergleichen war, deren Fahnen auf der einen Seite breiter als auf der andern ist." *

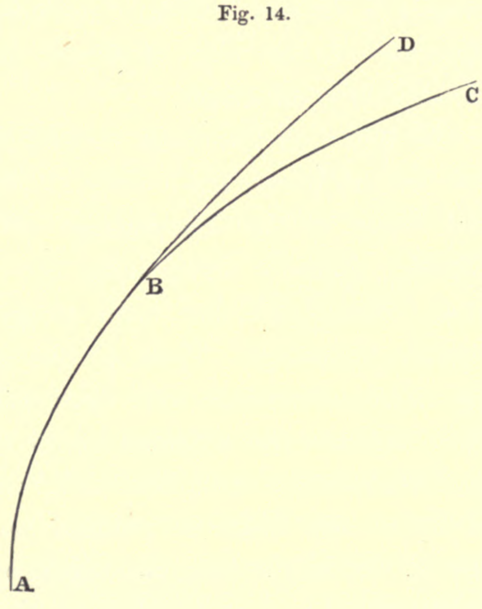
"Die federförmige Ausstrahlung auf der W. Seite ist noch deutlicher geworden, und die Breite des ganzen Schweifes hat noch zugenommen, während der helle Bogen in den beiden federförmigen Ausstrahlungen, keine regelmässig fortlaufende Krümmung zeigt."†

The following description is given by Heis.

"Aus der genau in die Charte gezeichneten äusseren Begränzungscurve habe ich die Gleichung dieser Curve zu bestimmen gesucht, jedoch noch keine bestimmte Gleichung finden können. Von der Parabel und Hyperbel weicht die Curve wegen bedeutender Krümmung des Endstückes derselben bedeutend ab. Mehr Aehnlichkeit hat dieselbe mit einer Halbellipse." ‡

I have been favored by Professor Heis with a copy of the chart referred to, accompanied by a diagram, from which Fig. 14 has been engraved. The following remarks are added.

Fig. 14.



"Die scharf begränzte äussere Curve A B C, vom 12 October, zum Beispiel, schien mir dem äussern Anblicke nach, von einer parabolischen oder hyperbolischen Curve wie A B D wegen bedeutenden Krümmung des Endstückes B C abzuweichen."

The general character of the deflection will be best comprehended by referring to the engravings of the view of the Comet to the naked eye, Plates VIII. to XX., although the effect is not given with all the fidelity that

* Beob. der Kaiserl. Sternw. Dorpat, Vol. XV. p. 58.

† Ibid.

‡ Astron. Nachrichten, 1169, p. 272.

could be wished, owing to the defect of the original drawings and descriptions. Upon the Charts, Plate XXVI. Sections I., II., III., it is scarcely apparent, because the outlines are designed to include the outer limits of decided light, without reference to its interior distribution; it will be seen, however, that the radius of curvature of the front edge does not increase continuously from the head upwards. It has one maximum just before reaching the region of deflection, and another beyond it, giving to the curve a character similar to that noticed by Heis in the passages above quoted.

We shall have a more effective representation of the deflection by tracing the course of the axis of brightness. For this purpose we may take as an illustration the distribution of the light of the tail on October 8. We will suppose the light from all the particles of a thin stratum, included between two contiguous cross-sections of the tail, to be concentrated into a single point, p, representing its centre of brightness. The curve joining all the positions of p, corresponding to the different strata, we may call the axis of brightness.

It will easily be seen, that, for the present Comet, this will differ much from the axis of figure, owing to the unequal brightness of the two sides of the tail. As far as the region of deflection, the axis of brightness lay between the front edge and the axis of figure. For an approximation, we may assume that, on October 8th, it was half-way between them. Higher up, it took more nearly the direction of the axis of figure, perhaps even tending to cross it, and showed scarcely any curvature.

For this date there are several figures of the tail, — namely, one made at Markree, one at Rome, for a copy of which I am indebted to the kindness of P. Secchi, and three at the Observatory of Harvard College, — in addition to descriptions affording data for determining the situation of the light-axis with tolerable correctness. Plate XXV. has been projected so as to present the outlines without perceptible distortion. Those of the front and rear edges have been laid down from the right ascensions and declinations derived from the chart on Plate XXVI. They indicate the extreme limits of light readily discernible to the naked eye. I have transferred upon Plate XXV(a) accurate tracings from the original figures made at Rome and Markree reduced to a common scale. The two small figures, and one of the larger size, are tracings from sketches by different observers, and made independently of each other, at the Observatory of Harvard College.

The following comparisons between the position of points on the normal front edge of the tail, and of corresponding points in the light-axis, will show the extent of the irregularity produced by the deflection for October 8th. The num-

could be wished, owing to the defect of the original drawings and descriptions. Upon the Charts, Plate XXVI Sections I, II, III, it is scarcely apparent, because the outlines are designed to include the outer limits of decided light, without reference to its interior distribution. It will be seen, however, that the radius of curvature of the front edge does not increase continuously from the head upwards. It has one maximum just before reaching the region of deflection, and another beyond it, giving to the curve a character similar to that noticed by Heis in the passages above quoted.

We shall have a more effective measurement of the deflection by tracing the course of the axis of brightness. For this purpose we may take as an illustration the distribution of the light of the tail on October 8. We will suppose the light from all the particles of a thin stratum included between two contiguous cross-sections of the tail to be concentrated into a single point, p, representing its centre of brightness. The curve passing through all the positions of p, corresponding to the different strata, we may call the axis of brightness.

It will easily be seen that, in the present Comet, this will differ much from the axis of figure, owing to the unequal brightness of the two sides of the tail. As far as the region of [illegible] the axis of brightness lay between the front edge and the axis of figure [illegible] stratum, we may assume that, on October 8th, it was [illegible]. Higher up, it took more nearly the [illegible] tending to cross it, and showed [illegible]

[illegible] tail, — namely, one made at Mark- [illegible] by the kindness of P. Secchi, [illegible] descriptions [illegible] correct- [illegible] without per- [illegible] down from [illegible] Plate XXVI. [illegible] naked eye. I have [illegible] from the original figures made at Rome and [illegible] The two small figures, and one of the larger [illegible] different observers, and made independently at [illegible] Harvard College.

The following [illegible] on the normal front edge of the tail [illegible] light-axis, will show the extent of the [illegible] October 8th. The [illegible]

COMET OF DONATI OCT 8 1858.

OUTLINES FROM ORIGINAL DRAWINGS.

bers represent the shortest distances from the light-axis to the front edge at the points indicated.

Point on "Light-Axis" from Nucleus.	Distance from Front Edge.	Point on "Light-Axis" from Nucleus.	Distance from Front Edge.
4°	0° 23′	24°	5° 33′
8	0 40	28	6 22
12	1 2	32	6 45
16	2 21	36	6 44
20	4 10	40	6 15

The following positions of points in the light-axis have been derived from the original drawings reduced to 7^h m. s. t. at the Observatory of Harvard College.

	α 1858.0.	δ 1858.0.
Collegio Romano, ...	228° 27′	+26° 35′
" "	226 25	+34 50
Markree, assuming the axis to be parallel	230 0	+28 0
with the upper outline, . . .	230 0	+32 0
" " . . .	230 0	+35 0
Observatory of Harvard College, . .	229 45	+23 15
" " . .	228 0	+27 30
" " . . .	224 10	+41 0

VI. COLUMNAR STRUCTURE OF THE TAIL.

During the interval between the 5th and 12th of October, the upper part of the tail was seen to be broken up into alternating dark and bright bands, 5° or more long, by 20′ or 30′ broad, nearly straight, and so disposed as to intersect the axis of the tail, in the region where they occurred, at angles of from 20° to 30°. Although the tail had here dispersed itself faintly over a large area without definite boundaries, the bands were yet distinctly outlined and separated by clearly marked dark intervals.

The first notices of them occur on the 5th of October, in the remarks by Lais at Dorpat, and on the 6th, in a sketch made at the Observatory of Harvard

College, where they were again seen on the 8th, 9th, 10th, and 12th, but most distinctly on the 8th. Five or six were visible at once, while others were indicated or faintly suggested. They had an aspect very closely resembling the streamers of an auroral arch.

In the Poulkova observations they are mentioned upon the 8th and 9th; they are also represented, though imperfectly, upon a lithograph accompanying the Altona observations of the 9th, and are described in the text* on this and the following evening.

In the details there are some discrepancies among the different accounts, as might have been anticipated from the difficulties of observation. Winnecke, at Poulkova, describes the beams as suddenly extending and contracting like those of the northern lights,† but no motion sensible to the eye was noticed at the Observatory of Harvard College. The mean angle by which the direction of the beams was inclined to that of the light-axis in the sketches made at the latter place on the 6th, 8th, 9th, and 10th, is 28°. Both notes and sketches are quite explicit as to the fact that they had but little mutual divergence, and that in those most distant from the nucleus the axes prolonged inclined strongly from the direction of the latter towards the sun. Winnecke instances two which diverged from a point about 20° above the nucleus.‡ The character of the phenomenon will be best understood from the engravings of the naked-eye views of the Comet, where, however, the details are necessarily quite imperfect.

VII. REDUCTION OF OBSERVATIONS ON THE SECONDARY TAILS.

The engravings of the naked-eye views of the Comet between September 27th and October 10th, Plates V. to XIX. inclusive, show the appearance of the faint and nearly straight rays which issued from the convex side of the principal tail. The positions of the axis of the principal ray have been ascertained with some

* Astron. Nachrichten, 1172, p. 317.

† Pulk. Beob. des Grossen Cometen 1858, p. 66.

‡ Ibid., p. 33.

degree of exactness from the data already collected on pp. 74 to 84, and are represented on the general Chart, Plate XXIV.

The observed points have been first projected upon the chart and reduced to the epoch 7^h m. s. t. at the Observatory of Harvard College. The distances of the reduced points on each date have next been measured from a straight line drawn from the nucleus through a point distant from it 20° and in the arc of a great circle drawn from the Sun through the nucleus and extended beyond it. The following are the right ascensions and declinations of points in this arc.

Right Ascension and Declination of Points in the Great Circle drawn from the Sun through the Nucleus.

			20° from Nucleus.		40° from Nucleus.	
			α 1858.0	δ 1858.0	α 1858.0	δ 1858.0
			° ′	° ′	° ′	° ′
Sept.	17	7^h Obs. H. C.	170 52	+ 56 24	163 12	+ 76 13
	18	"	172 34	56 23	166 21	76 14
	19	"	174 27	56 22	169 58	76 18
	27	"	196 29	52 38	212 33	71 19
	28	"	200 10	51 25	218 12	69 3
	29	"	204 0	49 55	223 38	67 20
	30	"	207 59	48 4	228 44	64 41
Oct.	1	"	212 6	45 55	233 36	61 37
	2	"	216 17	43 20	238 9	58 1
	3	"	220 30	40 20	242 25	53 53
	4	"	224 42	36 52	246 28	49 11
	5	"	228 51	32 56	250 18	43 57
	6	"	232 54	28 33	233 58	38 13
	7	"	236 49	23 47	257 28	32 5
	8	"	240 34	18 45	260 51	25 43
	9	"	244 7	13 32	264 8	19 15
	10	"	247 32	+ 8 21	267 21	+ 12 55

In order to interpolate the normal positions of the ray for each date, the results from the individual observations have been combined by the following process.

The shortest distances of the observed points reduced to the epoch 7^h, and measured from the straight line drawn as described above, have been represented by the expression

$$Aa + A'a^2 = d,$$

in which a is the distance in degrees of the point from the nucleus, and d the distance of the observed point from the line.

The following are the equations which have been obtained from the observations.

1858.		Weight.
Sept. 17	$0^\circ.95 = 7.9\,A + 7.9^2\,A'$	3
18	$0.37 = 7.7\,A + 7.7^2\,A'$	3
18	$0.32 = 6.1\,A + 6.1^2\,A'$	3
18	$0.24 = 3.8\,A + 3.8^2\,A'$	3
19	$0.32 = 7.4\,A + 7.4^2\,A'$	3
27	$0.00 = 4.5\,A + 4.5^2\,A'$	2
27	$0.90 = 13.9\,A + 13.9^2\,A'$	2
28	$0.12 = 4.2\,A + 4.2^2\,A'$	2
28	$0.66 = 10.1\,A + 10.1^2\,A'$	2
30	$0.10 = 3.4\,A + 3.4^2\,A'$	2
30	$0.35 = 6.0\,A + 6.0^2\,A'$	3
30	$1.22 = 7.7\,A + 7.7^2\,A'$	2
30	$1.50 = 7.7\,A + 7.7^2\,A'$	3
30	$1.00 = 12.1\,A + 12.1^2\,A'$	3
30	$1.60 = 21.0\,A + 21.0^2\,A'$	3
Oct. 1	$0.16 = 3.4\,A + 3.4^2\,A'$	2
1	$0.44 = 4.5\,A + 4.5^2\,A'$	3
1	$2.54 = 25.8\,A + 25.8^2\,A'$	3
1	$3.06 = 26.0\,A + 26.0^2\,A'$	3

1858.		Weight.
Oct. 2	$1^\circ.17 = 11.2\,A + 11.2^2\,A'$	3
2	$3.07 = 21.5\,A + 21.5^2\,A'$	3
3	$1.10 = 13.0\,A + 13.0^2\,A'$	3
3	$3.30 = 22.7\,A + 22.7^2\,A'$	3
3	$2.97 = 25.7\,A + 25.7^2\,A'$	2
3	$2.37 = 28.8\,A + 28.8^2\,A'$	2
4	$6.20 = 31.1\,A + 31.1^2\,A'$	3
5	$0.42 = 5.0\,A + 5.0^2\,A'$	2
5	$0.75 = 11.0\,A + 11.0^2\,A'$	3
5	$4.90 = 24.0\,A + 24.0^2\,A'$	3
5	$4.90 = 24.8\,A + 24.8^2\,A'$	3
6	$1.84 = 12.5\,A + 12.5^2\,A'$	3
6	$5.90 = 55.0\,A + 55.0^2\,A'$	3
7	$4.00 = 18.8\,A + 18.8^2\,A'$	6
8	$2.58 = 15.5\,A + 15.5^2\,A'$	3
8	$7.75 = 34.0\,A + 34.0^2\,A'$	3
10	$12.80 = 36.0\,A + 36.0^2\,A'$	3

These equations cannot be combined indiscriminately, because there is no reason to suppose that A and A' are sensibly constant excepting for short intervals. Those favorable for determining A' have been solved by the method of least squares, separately, from each group of points belonging to the same sketch or series of observations, in order to secure A', as far as possible, from the influence of relative errors in the positions of the projected points.

Its values are as follows:

Sept. 18	$A' = -\,0^\circ.00379$	Oct. 1	$A' = +\,0^\circ.00185$
27	$+\,0.00685$	2	$+\,0.00369$
28	$+\,0.00627$	3	$-\,0.00242$
30	$+\,0.00451$	5	$+\,0.00554$
30	$-\,0.00525$	6	$-\,0.00094$
Oct. 1	$+\,0.00232$	8	$+\,0.00332$

These numbers indicate that we have not sufficient data for a reliable determination of A'; we shall therefore make $A' = 0$. On this supposition we have from the original equations the following numbers.

1858.	Sept.	17	$A = +\overset{\circ}{0}.120$	1858.	Oct.	3	$A = +\overset{\circ}{0}.110$
		18	0.053			4	0.199
		19	0.043			5	0.172
		27	0.049			6	0.115
		28	0.055			7	0.213
		30	0.084			8	0.209
	Oct.	1	0.102				
		2	+ 0.127			10	+ 0.356

It may be added, that, in making $A' = 0$ in the equation

$$d = A\,a + A'a^2,$$

the projected path of the ray does not necessarily become a straight line. In fact, owing to the change of the scale on the chart at different distances from the nucleus, its course projected from the equation

$$d = A\,a$$

presents a decided curvature in the same direction with the outline of the principal tail on those dates when the length of the ray was considerable, as may easily be seen by referring to the chart.

The adopted values of A, derived by interpolation from the above, are as follows: —

1858.	Sept.	17	$A = \overset{\circ}{0}.065$	1858.	Oct.	3	$A = \overset{\circ}{0}.122$
		18	0.065			4	0.141
		19	0.065			5	0.164
		27	0.050			6	0.191
		28	0.057			7	0.221
		29	0.066			8	0.253
		30	0.078			9	0.288
	Oct.	1	0.091			10	0.325
		2	0.106				

which have been used in projecting the position of the axis of the ray on the chart, Plate XXIV.

For the breadth of the ray the expression

$$\text{Breadth} = 14' + 1'.0\,(a - 5^\circ)$$

will satisfy tolerably well such observations as we have of this element.

The following have been used for the length of the ray.

1858. Sept.	17	Length 8°	1858. Oct.	3	Length 29°
	18	8		4	35
	19	8		5	55
	27	14		6	55
	28	16		7	53
	29	19		8	50
	30	21		9	45
Oct.	1	27		10	39
	2	27			

The axis of the ray at its origin makes the following angles with the great circle from the sun through the nucleus prolonged, if we suppose it to be correctly projected by the formula adopted,—

$$\text{Values of } \theta = \sin.^{[-1]} \frac{A}{1^\circ}.$$

1858. Sept.	17	$\theta = 3^\circ.7$	1858. Oct.	3	$\theta = 7^\circ.0$
	18	3.7		4	8.1
	19	3.7		5	9.4
	27	2.9		6	10.9
	28	3.3		7	12.8
	29	3.8		8	14.7
	30	4.4		9	16.7
Oct.	1	5.2		10	19.0
	2	6.1			

The last numbers of this series, especially, are not much to be relied upon. In fact, none of the observed points in the ray were near enough to the nucleus to admit of a satisfactory determination of its direction there.

Substituting the concluded values of A in the original equations, we have the subjoined differences.

1858. Sept.	17	$c - o = + 0^\circ.44$	1858. Sept.	28	$c - o = - 0^\circ.16$
	18	$-$ 0.13		28	0.00
	18	$-$ 0.08		30	$-$ 0.16
	18	$-$ 0.01		30	$-$ 0.11
	19	$-$ 0.16		30	$+$ 0.62
				30	$-$ 0.10
	27	$-$ 0.22		30	$+$ 0.06
	27	$+$ 0.21		30	$-$ 0.03

1858. Oct.	1	$c - o = -0^{\circ}.15$	1858. Oct.	5	$c - o = -0^{\circ}.40$
	1	-0.06		5	-1.05
	1	$+0.19$		5	$+0.96$
	1	$+0.69$		5	$+0.83$
	2	-0.01		6	-0.54
	2	$+0.80$		6	-4.60
	3	-0.50		7	-0.15
	3	$+0.51$			
	3	-0.19		8	-1.35
	3	-1.17		8	-0.87
	4	$+1.83$		10	$+1.10$

A positive sign prefixed to $c - o$ indicates that the normal position of the ray is in advance of the observed point.

VIII. OBSERVATIONS UPON THE NUCLEUS AND ENVELOPES.

In this Section will be included observations relating to the figure of the head of the Comet, and to the internal disposition of its nebulosity, and to the size, brightness, and other peculiarities of the nucleus. The variety of the phenomena described would seem to favor a subdivision under several distinct headings, in order to secure a separate consideration for each; but this would have made it necessary in many instances either to alter the original language of the notes, or else to retain it at the expense of frequent repetitions and other inconveniences, which could not be avoided in quotations from the published descriptions, where, from the little attention paid to method or uniformity in the arrangement, the references to different features occur in such connections that they cannot be extracted and placed by themselves without injury to the sense and force of the description. The present plan, moreover, associates, under one view, various details of structure which are plainly related to each other as successive stages in the development of the same phenomenon, and which require to be retained in their natural connection in order to be properly understood.

In comparing together the various descriptions of the telescopic aspect of the Comet, it will at once appear that the evidence is frequently of the most conflicting and contradictory character. Differences in the optical capacity of the telescopes employed, or in the clearness of the atmosphere, and perhaps subjective impressions and preconceived opinions respecting the nature of the phenomena under observation, have given rise to innumerable discrepancies which tend greatly to confuse the subject. In the engravings accompanying the text of many of the accounts, although they serve a very useful purpose in illustrating the meaning of the writer, these sources of confusion have been further aggravated by the mechanical difficulties of executing correct representations of the Comet.

Under these circumstances, with little in the previous history of comets, or in the existing state of our knowledge of their constitution, to suggest explanations and to assist in reconciling conflicting statements, an exposition of the whole mass of observations, in a form which will admit of their being easily compared with each other, is the plan most likely to lead to correct inferences, by indicating the points established by a general agreement, and those respecting which the testimony is insufficient or conflicting. In the comments which have been occasionally introduced, views have not unfrequently been expressed, at variance with the conclusions which others have adopted. This has affected materially the language of description, as, for instance, in treating of the details of the structure of the envelopes, the manner in which they were thrown off from the nucleus, and their subsequent development and dissipation.

In order to the entire completeness of the description of the head of the comet, quotations already given in Section I., relating to the part of the tail contiguous to the nucleus and included in the telescopic view, have been in some instances repeated in the present Section. A full exposition of the observations has perhaps led to the occasional introduction of matter scarcely deserving special notice; but our present ignorance of the true character of cometary phenomena will be a sufficient reason for not exercising too close a discrimination in the selection of data for their investigation.

A description is subjoined of the telescopes employed by the several observers, so far as I have been able to ascertain them. The list comprises five telescopes, having apertures exceeding 13.3 inches, five of apertures between 11 and 12.5 inches, and twelve between 6.33 and 9.6 inches. The remainder are of less than 6 inches.

List of Telescopes employed for the Observations upon the Head of the Comet.

BRADSTONES, ENG. LASSELL.

Reflector of 20 feet focal length. Aperture 24 inches.

OBSERVATORY OF HARVARD COLLEGE. BOND.

Refractor by Merz. Focal length 22.5 feet. Aperture 14.95 inches. A power of 144 was ordinarily used. A Comet-Seeker of 4 inches aperture, and the Finder of the great Refractor, aperture 3 inches, were also used.

POULKOVA. STRUVE.

Refractor by Merz. Focal length 22.7 feet. Aperture 14.95 inches.

OBSERVATORY OF HAMILTON COLLEGE, CLINTON, N. Y. C. H. F. PETERS.

Refractor by Spencer. Focal length 16.5 feet. Aperture 13.5 inches. A power of 80 was ordinarily used.

MARKREE. COOPER, GRAHAM, ROBERTSON.

Refractor. Focal length 25.3 feet. Aperture 13.3 inches.

PARIS. CHACORNAC.

Refractor. Focal length 16 (?) feet. Aperture 12.6 inches.

ANN ARBOR, MICH. BRÜNNOW.

Refractor by Fitz. Focal length 17 feet. Aperture 12.5 inches.

CAMBRIDGE, ENG. CHALLIS, BREEN.

Refractor. Focal length 19.5 feet. Aperture 11.5 inches. Power 166.

MUNICH. LAMONT.

Refractor. Focal length 16 feet. Aperture 11.2 inches.

FLORENCE. DONATI.

Refractor. Focal length 17 feet. Aperture 11 inches.

DORPAT. MÄDLER.

Refractor by Frauenhofer. Focal length 13.7 feet. Aperture 9.6 inches.

BERLIN. FÖRSTER, BRUHNS.

Refractor. Focal length 13.9 feet. Aperture 9.6 inches.

COLLEGIO ROMANO. SECCHI, ROSA, CAPELLETTI.

Refractor by Merz. Focal length 15 feet. Aperture 9.6 inches.

LIVERPOOL. HARTNUP.

Refractor. Object-Glass by Merz. Focal length 12 feet. Aperture 8.5 inches.

OXFORD, ENG. POGSON.

Heliometer. Object-Glass by Merz. Focal length 10.5 feet. Aperture 7.5 inches.

CHRISTIANIA. FEARNLEY.

Refractor by Merz. Focal length 10 (?) feet. Aperture 7.5 inches.

POULKOVA. WINNECKE.

Heliometer by Merz. Focal length 10.2 feet. Aperture 7.4 inches. A Comet-Seeker of 3 inches aperture was also used.

HADDENHAM. DAWES.

Refractor by Clark. Focal length 9.5 (?) feet. Aperture 6.9 inches.

CAPE OF GOOD HOPE. MACLEAR.

Refractor by Merz. Focal length 8.5 feet. Aperture 6.9 inches. A part of the observations in Section I. were made with a Refractor of 46 inches focal length, aperture 2.75 inches.

SANTIAGO. MOESTA.

Refractor. Object-Glass by Fitz. Focal length 9.4 feet. Aperture 6.8 inches.

GREENWICH. AIRY, MAIN, CHRISTY.

Observations were made chiefly with Refractor. Object-Glass by Cauchoix. Focal length 8.2 feet. Aperture 6.7 inches.

VIENNA. HORNSTEIN (?), WEISS (?).

Refractor. Focal length 8 (?) feet. Aperture 6.4 inches.

LEYDEN. HOEK.

Refractor by Merz. Focal length 8.5 feet. Aperture 6.4 inches.

. . . . . . HODGSON.

Refractor. Focal length 7.5 feet. Aperture 6.33 inches.

KREMSMÜNSTER. RESLHUBER.

Refractor. Focal length 7.5 feet. Aperture 5.9 inches.

TRETIRE. WEBB.

Refractor by Clark. Focal length 6 (?) feet. Aperture 5.5 inches.

OXFORD. SLATTER.

Refractor. Focal length 7 feet. Aperture 5 inches. On October 11 a Refractor of 2.75 inches aperture was used.

SPALDING. SELBY.

Refractor. Focal length 6.5 feet. Aperture 5 inches.

GÖTTINGEN. AUWERS.

Refractor. Focal length 6.4 feet. Aperture 4.8 inches.

DESSAU. SCHWABE.

Refractor. Focal length 6.4 feet. Aperture 4.6 (?) inches.

WILLIAMSTOWN, VICTORIA. ELLERY.

Two telescopes are mentioned in Mr. Ellery's letters. A 6-foot Refractor by Steinheil, of 4.5 inches aperture; and a 5-foot Refractor by Merz, of 3.5 inches aperture.

GENEVA. PLANTAMOUR.

Refractor. Focal length 5.33 feet. Aperture 4.25 inches.

BRESLAU. GALLE.

Refractor by Frauenhofer. Focal length 4.3 feet. Aperture 4 inches.

COPENHAGEN. D'ARREST.

Refractor by Frauenhofer. Focal length 5.3. Aperture 3.75 inches.

HIGHBURY. BURR.

Refractor. Focal length 4 (?) feet. Aperture 3.375 inches.

ALTONA. PAPE.

Refractor by Frauenhofer. Focal length 4.3 feet. Aperture 3.25 inches.

Refractor by Frauenhofer. Focal length 3.75 (?) feet. Aperture 3 (?) inches.

Observations upon the Nucleus and Envelopes.

The discovery of the Comet on the 2d of June was announced by the following telegraphic despatch, which appeared in the Paris Bulletin of June 10th. It was discovered independently, in America, by H. P. Tuttle, at the Observatory of Harvard College, June 28th; by H. M. Parkhurst, at Perth Amboy, N. J., June 29th; and by Miss Mitchell, at Nantucket, July 1st.

1858. June 2.

Florence. Donati. (*Bulletin Obs. Imp. de Paris.*)

"Dépêche télégraphique de Florence.

"J'ai observé une comète qui, peut-être, est nouvelle. Position estimée; le 2 Juin à 10 heures; AR $= 141° 9'$. Dec. $= + 23° 55'$. . . . . .

"La comète est très-faible."

The following description is given by Donati in a later communication to the Bulletin.

"Le 2 Juin, lorsque je découvris cette comète, elle se montrait comme une petite nébulosité ayant un diamètre d'environ 3′, et d'une lumière également intense sur toute son étendue.

"Cette apparence resta la même jusqu'au mois d'Août, dans le courant duquel la comète présenta à son centre une condensation de lumière très-sensible qu'on n'aurait pu cependant pas appeler un noyau."

The reader will notice that in this account, so far as it relates to the appearance of the Comet in the month of July, the expression "d'une lumière également intense," etc., is not in accordance with the testimony of other observers.

1858. June 9.

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 12.)

"Quando fu scoperta dal Sig. Donati ed osservata da noi la prima volta la sera del 9 Giugno, essa era 'una nebulosità larga 3′ indecisa e irregolarmente terminata agli orli senza nucleo propriamente detto, ma solo con una maggior condensazione di luce presso il centro.'"

1858. June 15.

Berlin. Bruhns. (*Astron. Nachrichten*, 1205, p. 70.)

"Um Mitte des Juni, gleich nach seiner Entdeckung, glich der Comet im Refractor mit 90facher Vergrösserung einem äusserst schwachen $1\frac{1}{2} - 2'$ Durchmesser haltenden Nebel."

1858. June 28.

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

The position of an object detected with the comet-seeker, by Mr. H. P. Tuttle, was observed with the great refractor. It proved to be the comet of Donati. It was observed also on the 13th and 15th of July, showing a strong stellar nucleus, but no tail.

1858. June and July.

VIENNA. HORNSTEIN. (*Annalen der k. k. Sternw. in Wien*, F. III. IX. p. 177.)

"Im Juni und Juli erschien der Comet als sehr schwacher Nebel mit einer auffallend kleinen hellen Verdichtung in der Mitte."

1858. July 7.

ALBANY. SEARLE. (*Astron. Journal*, No. 115, p. 149.)

"The Comet is very diffuse and without definite nucleus."

1858. July 19.

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"The Comet could be observed without difficulty upon the illuminated mica scale attached to the micrometer of the great refractor, although it was seen through a dense haze, and near the horizon, showing that it must be brighter than the average of telescopic comets, which we can rarely observe in this way. With a strong illumination of the lines, (rendered necessary by the twilight in order to make them appear brighter than the background of the sky,) most of the diffused light of the Comet was obliterated, but there still remained a central nucleus 5″ in diameter, which could be observed with precision." This probably includes the dense nebulosity immediately surrounding the true nucleus, and not distinguishable from it.

1858. August 1.

BERLIN. BRUHNS. (*Astron. Nachrichten*, 1205, p. 70.)

"Erst im Anfang August gelang es, ihn wieder als einen in der Mitte ziemlich verdichteten Nebel zu sehen."

1858. August 5.

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 260.)

"Durchmesser bei 2 Bog. Minuten; ich konnte weder einen auffallenden Kern noch einen Schweif erkennen."

1858. August 7.

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 206.)

"Her i Kjœbenhavn var det paa Grund af de lyse Nætter og endnu mere af Mangel paa noget fastopstillet, parallaktisk Instrument paa Observatoriet i hele

to Maaneder umulig blot at faae Œie paa Kometen, der i hele den Tid stod meget dybt, og tidligt om Aftenen skjulte sig i Dunsterne ved Horizonten. Fœrst den 7de August skimtede jeg Kometen som en temmelig svag, liden Taage, fuldkommen rund og aldeles uden Spor af Hale. Fra den Tid af blev Kometen, der kort efter begyndte at udvikle en lang Række af meget usædvanlige og særdeles paafaldende Phænomener, hver Aften observeret med en femfods Fraunhofersk Kikkert. (Aabning 42 Par. Linier.)"

1858. August 14.

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 208.)

"Kometen viste sig i henved 14 Graders Hœide som en Stjerne af 5-6te Stœrrelse, en rund Taageplet, 35″ i Diameter, med et skarpt lysende Midtpunkt; Spor af en Hale paa 3 til 4 Bueminuters Længde i Kometsœgeren."

VIENNA. HORNSTEIN. (*Annalen der k. k. Sternw. in Wien*, F. III. IX. p. 177.)

"Am 14 August war der Comet schon sehr hell, und trotz seines tiefen Standes, und des störenden Mondscheins ein Schweif von nahe $\frac{1}{6}$ Grad Länge zu erkennen."

1858. August 19.

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"Comet much brighter than when last observed (August 5th). Nucleus equals a star of the 7th magnitude. . . . . .

"Comet low in the twilight, red, concentrated, and fiery, with traces of a tail."

For remarks upon the aspect of the tail in this early stage of its formation, see Section I. pp. 2-8.

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 1.)

"Am 19 August, erkannten wir ihn zum ersten Mal mit blossem Auge."

This is the earliest notice of the visibility of the Comet to the naked eye; it was not generally recognized without the aid of a telescope before the end of the month.

1858. August 23.

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 209.)

"Kometen var betydeligen tiltagen i Glands; Kjernen lignede i Aften i Lysstyrke en Stjerne paa fjerde Stœrrelse."

1858. August 24. (Plate XLIX. 1, and Fig. 1.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 209.)

"Kjærnen syntes i Aften særdeles skarpt fremtrædende. Halens Længde henved 6 Bueminuter; dens hœire (œstlige) Rand var noget skarpere begrændset end den

venstre forangaaende; overhovedet var der af Halen, formedelst den endnu meget lyse Baggrund, kun Randene synlige."

Plate XLIX. 1, and Fig. 1. of Section I. p. 4, have been taken from D'Arrest's figure.

1858. August 28.

BERLIN. BRUHNS. (*Astron. Nachrichten*, 1205, p. 70.)

"Am 28sten Aug. sah ich ihn zuerst mit blossem Auge, er stand nicht allzu hoch und Sterne 5ter – 6ter Grösse in seiner Nähe konnte ich eben erkennen."

This, with the following, are the earliest notices of the visibility of the Comet to the naked eye, excepting at Poulkova, where it was seen nine days earlier. It was seen at the Observatory of Harvard College on the 29th, at Kremsmünster and London on the 30th, and at Copenhagen on the 31st.

VIENNA. WEISS. (*Annalen der k. k. Sternw. in Wien*, F. III. IX. p. 177.)

"Am 28 August wurde der Comet hier zum ersten Male mit freiem Auge gesehen."

1858. August 29.

OBSERVATORY OF HARVARD COLLEGE. TUTTLE.

"Found Donati's Comet in strong twilight; a few minutes later saw it distinctly with the naked eye as bright as a star of the 2 – 3d magnitude would have been at the same altitude."

1858. August 30.

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"Nucleus 6″ in diameter and very bright."

. . . . . HODGSON. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 86.)

"The Comet was barely visible with the naked eye, though easily found with an opera-glass."

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 260.)

"Bei sehr reinem Himmel Komet sehr hell, bereits mit freiem Auge sichtbar. Die Helligkeit hat sehr stark zugenommen; die Mitte des Kometen ein fast planetenartiges Scheibchen."

1858. August 31. (Plate XLIX. 2, and Fig. 2.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 209.)

"Halen har siden August 24 faaet en meget betydelig Udvikling (Fig. 2); dens hœire Rand (i Kikkerten) viser sig skarpt begrændset, hvorimod den venstre udvaskede Rand ikke frembyder nogen bestemt Contour. Kometen var paa hiin Aften godt af tredie eller fjerde Stœrrelse, men paa den lyse Himmelgrund begyndte den fœrst nu at vise sig for det blotte Œie."

1858. September 1.

BERLIN. FÖRSTER. (*Astron. Nachrichten*, 1205, p. 68.)

"Positionswinkel der Schweif-Mitte = 4°.95."

1858. September 2. (Plate XLIX. 3.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 210.)

"Indeni Kjærnen, hvis Diameter skjœnnedes = 10″, skimtede jeg med den stærkeste Forstœrrelse Noget som lignende en Stjerne af 3–4de Stœrrelse paa neppe mere end 1 eller 2 Buesecunders Diameter. Halen, der nu begyndte at vise en betydelig Bœining, saaes i den Fraunhoferske Kikkert omtrent 20 Minuter lang; i Kometsœgeren derimod kunde den allerede nu fœlges over halvanden eller maaskee to Grader."

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 260.)

"Bei sehr reinem Himmel Komet sehr lichthell, Kern gut markirt."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 2.)

"20^h 30^m — 20^h 50^m. Der Abstand des Kerns vom Südende des Cometen auf 1′.5 geschätzt. Die Breite des Cometen auf dem Parallel des Kerns beträgt 3′.5. Die mittlere Richtung des Schweifs, in wenigen Minuten Abstand vom Kern, wurde gemessen; auf der vorangehenden Seite zu 350°.9, auf der nachfolgenden zu 21°.7. Der Durchmesser des kreisrunden Kerns geschätzt auf 2″–3″.

"Anmerkung. Eine während der Beobachtung eilig hingeworfene Skizze stimmt mit diesen Angaben sehr gut überein, und deutet zugleich darauf hin dass ein dunklerer Zwischenraum in der Mitte des Schweifs schon in 3′ Entfernung vom Kern bemerkt wurde."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 19, 20.)

"21^h Sternz. Der Comet stand heute in der Nähe von 46 und 47 Fl. Leon. min., so dass die Helligkeit des Kernes bequem und sicher mit diesen Sternen verglichen werden konnte. Im Sucher macht der Kern einen etwas stärkern Lichteindruck als 47 Fl., nach Argelander 6ter Grösse, und nach Art der veränderlichen Sterne mit einander verglichen, würde ich den Kern 4–5 Stufen heller schätzen. Er war sehr beträchtlich schwächer als 46 Fl., 4 Grösse nach Argelander. Dem blossen Auge erscheint der Kopf des Cometen viel heller als 46 Fl. Als der Comet und Cor Caroli gleiche Höhe hatten, waren sie für das blosse Auge an Helligkeit nahe gleich, Cor Caroli ein wenig heller."

(Ibid., p. 21.)

"Im Anfange meiner Beobachtungen mittelst des Heliometers zeigte der Kopf

des Kometen keine auffallenden Erscheinungen; der Kern hob sich als eine sehr plötzlich bedeutend hellere, schlecht begränzte, planetarische Scheibe von einem ziemlich gleichmässig hellen Nebelstoffe ab, der in der Richtung zur Sonne gut begränzt erschien und gegen anderthalb Minuten vom Kerne abstand; die äussere Begränzung hatte eine annähernd parabolische Krümmung."

(Ibid., pp. 27, 28.)

"Ueber Ausdehnung und Aussehen des Schweifes ist heute Nichts notirt, der Positionswinkel p des Schweifes ist zu drei verschiedenen Malen gemessen und die geringe Uebereinstimmung der Resultate beweist, dass die Auffassung der Mittellinie des Schweifes grössere Schwierigkeiten gemacht hat, als an spätern Tagen. Ich bemerke hier gleich zu Anfange der Bestimmungen über die Richtung des Schweifes, dass ich mich immer bestrebt habe, die Mittellinie der Figur desselben einzustellen. Bei andern bekannt gewordenen Messungsreihen, die denselben Gegenstand betreffen, ist die Richtung des dunklen Raumes, im Schweife eingestellt, welche mit der von mir gemessenen Richtung keineswegs zusammenfiel. Die zu den Betrachtungen und Messungen über den Schweif angewandte Vergrösserung des Heliometers war fast immer die schwächste vorhandene; nur wenige Male sind stärker vergrössernde Oculare angewandt. Das schon früher erwähnte Netz aus dicken Metallfäden machte die Bestimmung der Richtung des Schweifes ziemlich leicht, da sie auf dem hellen Grunde immer vortrefflich ohne jegliche Beleuchtung sichtbar waren; nur zweimal habe ich mich des eigentlichen Heliometerapparates bedient, um die Richtung des Schweifes zu bestimmen. Ich fand dass die Sicherheit der Beobachtungen damit durchaus nicht grösser war; denn die Helligkeit des Kopfes überwog das Licht des Schweifes in den entferntern Partien zu sehr. Wohl aber war der dadurch herbeigeführte Zeitverlust ein so bedeutender, dass bei der kurzen Dauer der vortheilhaften Sichtbarkeit des Cometen, zumal in den letzten Tagen seiner Erscheinung, die nöthige Zeit nur durch Aufopferung anderer Bestimmungen hätte gewonnen werden können.

Die Messungen vom 2 Sept. sind:

Pulk. Sternz. $20^h\ 35^m$	$p =$	$5°.35$	4 Beob.
$0\ \ 24$		0.98	5 "
$0\ \ 51$		5.77	3 "

"Die letzte Bestimmung wurde mit dem Heliometer als solchem gemacht, ist aber nur einseitig gemessen, wesshalb ich sie im Folgenden nicht weiter gebrauchen werde, sondern als Resultat dieses Abends $p = 3°.16$ für $22^h\ 29^m$ Sternz. gültig annehmen werde."

1858. September 3.

FLORENCE. DONATI. (*Bulletin Obs. Imp. de Paris.*)

"Le 3 septembre la Comète devint visible à l'œil nu; et à l'aide des grossissements faibles appliqués à la lunette, on apercevait, au milieu de la tête de la Comète une sorte de noyau suffisamment défini qui possédait une lumière tranquille, et dont la forme était elliptique, avec le grand axe perpendiculaire à la direction de la queue, dont la longueur était alors d'environ 2°. Avec les forts grossissements le noyau disparaissait presque, n'offrant plus alors de limites distinctes.

"Les jours suivants, le diamètre de ce noyau supposé, allait toujours en décroissant, et sa forme, d'abord elliptique, se modifiait. Le noyau se définissait de plus en plus; sa lumière devenait plus vive, et la nébulosité qui l'entourait semblait se dilater successivement."

GENEVA. PLANTAMOUR. (*Note sur la Comète de Donati,* p. 1.)

"Dès le 3 septembre j'ai pu distinguer la Comète à l'œil nu."

1858. September 4. (Plate XLIX. 4.)

BERLIN. FÖRSTER. (*Astron. Nachrichten,* 1205, p. 67.)

"Der Comet sehr nahe gleich hell mit einem Stern $4^m.5$."

ALBANY. SEARLE. (*Astron. Journal,* 119, p. 182.)

"The Comet first seen with the naked eye, the weather having been cloudy since August 24. Mr. Searle estimated the appearance as being like that of a star of the third magnitude, with a very slight tail."

COLLEGIO ROMANO. SECCHI. (*Mem. dell' Osserv. del Coll. Romano,* 1859, p. 12.)

"Tale a un dipresso si conservò il suo aspetto fino al 4 settembre; allora il suo nucleo era divenuto più deciso. . . . . . Il nucleo però non sosteneva forti ingrandimenti e solo coll' applicarvi 300 già diveniva sfumatissimo, il che è stato sempre vero durante tutta la sua apparizione. Ciò si accorda con quello che pure ha veduto il Signor Donati a Firenze, il quale nota di più, che questo supposto nucleo andava sempre diminuendo di diametro e perdendo la sua forma apparentemente ellittica, nel mentre che venia mostrandosi più definito, e acquistando luce sempre più viva, la nebulosità che lo circondava dilatavasi successivamente."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen,* 1858, p. 20.)

"$20^h\ 9^m$ Sternz. Comet sehr schön gesehen; mit der stärksten 335 f. Vergrösserung ist ein schlecht begränzter, doch entschieden scheibenartiger Kern da. Durchmesser nach drei gut harmonirenden Messungen $6''.55$ in einer Richtung nahe senkrecht auf die Schweifaxe."

(Ibid., p. 21.)

"Scheitelradius der Coma 1′.3."

(Ibid., p. 28.)

"20^h 29^m Sternz. $p = 1°.54$. 8 Einst.

"Es wurde der Positionswinkel durch Einstellen des Cometenkopfes in die Mitte des Schweifes 18′ vom Kerne entfernt, gemessen."

1858. September 7.

CAMBRIDGE, ENG. BREEN. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 16.)

"Very conspicuous to the naked eye, being nearly of mag. 2. Long and broad tail pointed directly north."

BERLIN. FÖRSTER. (*Astron. Nachrichten*, 1205, p. 68.)

"Positionswinkel der Schweif-Mitte = 0°.50."

(Ibid., p. 69.)

"Durchmesser des Kerns reducirt auf die Entfernung 1 = 8″.9."

1858. September 8. (Plates XXVII. and XLIX. 5.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 210.)

"Kometen saaes meget glimrende; Kjærnen lignende nu en Stjerne af tredie Stœrrelse, og om end den stod meget lavt, var den særdeles godt og skarpt synlig."

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"The Comet was followed this morning in the great refractor up to 17^h 21^m m. s. t. Only the nucleus of 3″ diameter, and a little nebulosity extending to a diameter of 5″, could barely be distinguished at 17^h 17^m. When the Comet was best seen, the nucleus was 8″ in diameter, remarkably intense and star-like, and as bright as a star of the 5th magnitude at the same proximity to the horizon. To the naked eye it appeared as a star of the 4th magnitude, with a brush of light 2° long. The nebulosity on the side towards the sun was very faint beyond a distance of 1′ from the nucleus."

HIGHBURY, ENG. BURR. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 26.)

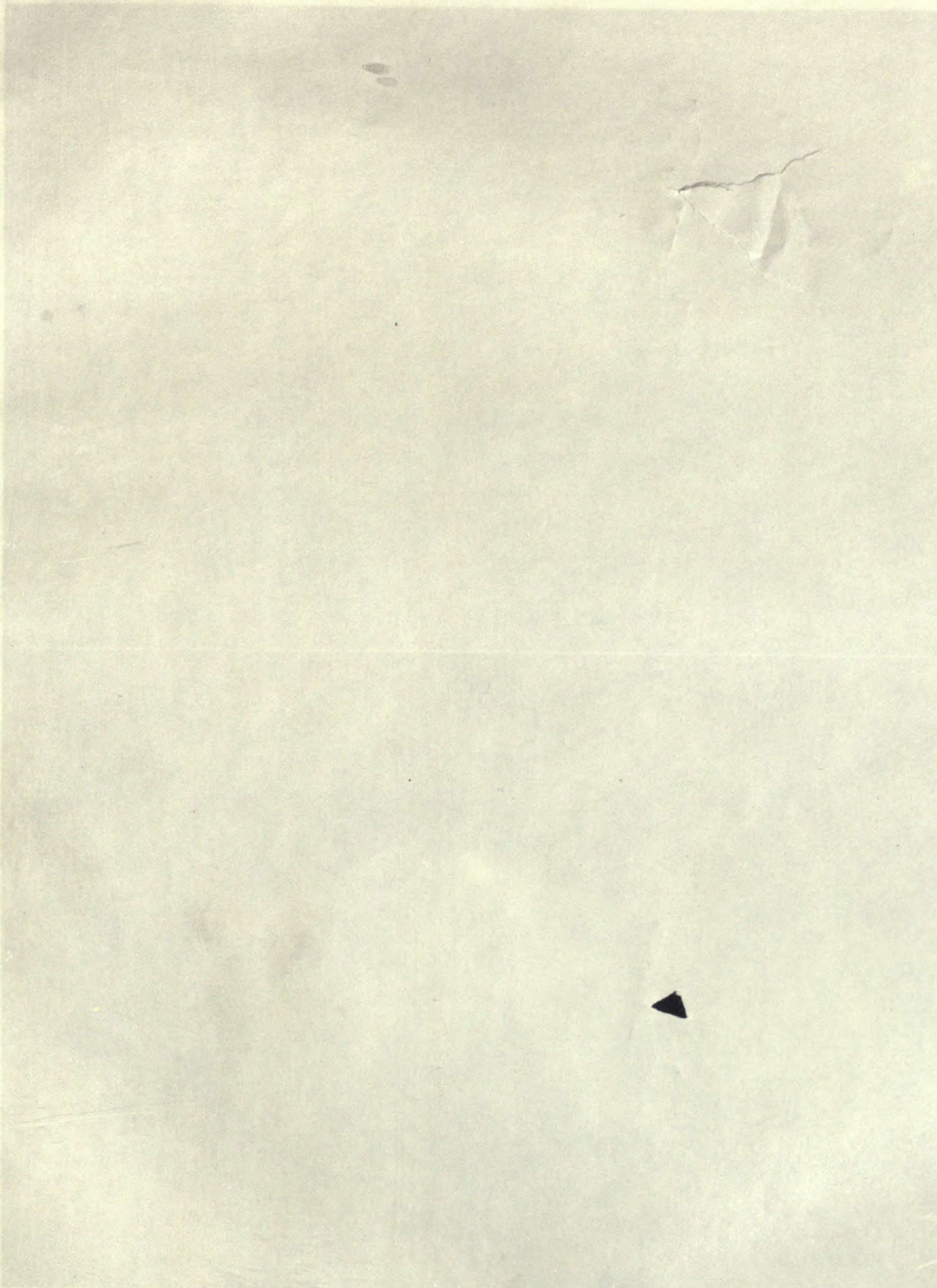
"The nucleus bright and stellar in appearance."

An engraving of the telescopic aspect of the Comet on September 8th (morning of September 9th) will be found on Plate XXVII. The apparent right-hand side of the head was brightest, as stated on the 12th.

1858. September 10.

PARIS. CHACORNAC. (*Bulletin Obs. Imp. de Paris.*)

"J'ai commencé le 10 septembre à observer la Comète de Donati avec la



([illegible] p. 21.)

"[illegible]radius der Coma [illegible]"

([illegible] p. 28.)

"[illegible] 29ᵐ Sterne [illegible]

"Es wurde der Positionswinkel [illegible] des Cometenkopfes in die Mitte des Schweifes [illegible] vom Kerne entfernt gemessen."

1858 [illegible]

[illegible] (Monthly Notices Royal Astr. Soc., Vol. XIX. p. 16.)

"Very conspicuous to the naked eye, being nearly of mag. 2. Long and broad tail pointed directly north."

[illegible] (Astron. Nachrichten, 1858, p. [illegible])

"Positionswinkel der [illegible]"

([illegible])

"[illegible] des Kerns [illegible] auf die Entfernung [illegible]"

1858. September 8. [illegible] XLIX.

[illegible] (Oversigt over det ... Videnskabernes Selskabs [illegible] p. 210.)

"[illegible] Kjernen [illegible] som en Stjerne af tredie [illegible] god og skarpt [illegible]"

[illegible] G. P. BOND.

"[illegible] morning in the great refractor up to 17ʰ 21ᵐ [illegible] diameter, and a little nebulosity extending to a [illegible] distinguished at 17ʰ 17ᵐ. When the Comet was [illegible] diameter, remarkably intense and star-like, and as [illegible] at the same proximity to the horizon. [illegible] of the 4th magnitude with a brush [illegible] the side towards the sun was very faint be- [illegible]"

R.

[illegible]

"[illegible]"

An [illegible] of the Comet on September 8th (morning of September [illegible]) [illegible] Plate XXVII. The apparent right-hand [illegible] of the head was [illegible] of the Plate.

1858. September 10.

[illegible] (Annales [illegible])

"[illegible] 10 septembre, a observer la Comète [illegible] avec la"

COMET OF DONATI 1858.

SEPTEMBER 8TH 16H M.S.T. OBSERVATORY OF HARVARD COLLEGE PLATE XXVII

G.P. Bond Del.

J. W. Watts Sc.

COMET OF DONATI 1858.

SEPTEMBER 20TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE PLATE XXVIII

Printed by Chas. D. Andrews.

grande lunette équatoriale de MM. Secretan et Eichens en employant des grossissements variant de 60 à 770 fois; ces grossissements donnant tous de belles images des étoiles.

"Le 10 septembre le noyau de la Comète, examiné avec le plus faible grossissement, paraissait rond et très-brillant; la chevelure qui l'enveloppait était un faible éclat; il s'en détachait nettement comme un disque planète. A mesure que l'on appliquait à la lunette des grossissements de plus en plus forts, cet aspect se modifiait; une nébulosité, d'abord faible, grandissait successivement, à tel point qu'avec le grossissement de 770 fois, le noyau de la Comète apparaissait comme une nébuleuse ayant seulement une concentration de matière à son centre.

"A l'œil nu, le noyau environné de la chevelure, paraissait d'un éclat au moins égal à celui des étoiles les plus brillantes de la queue de la grande Ourse. Des comparaisons photométriques directes ont montré que la partie la plus lumineuse du noyau vu avec le faible grossissement, était cependant d'un éclat inférieur à celui de l'étoile (ν) grande Ourse. Ce même jour, la lumière de la Comète n'offrait pas visiblement de lumière polarisée.

"La chevelure qui entourait le noyau de la Comète ne présentait rien de remarquable; elle s'étendait uniformément de part et d'autre sans présenter de différences d'éclat nettement accusées; sa lumière faible *se confondant graduellement avec le fond sombre du ciel sans présenter de limites tranchées.*"

Neuchatel. Jeanjaquet. (*Souvenirs de la Comète de* 1858, p. 4.)

"Le 10 septembre 1858, vers 7 heures 40 minutes du soir, tout près de l'horizon, au nord-ouest. Noyau marquant. Il se montre aussi visible que Megrez de la grande Ourse, et si l'on tient compte des positions relatives, on ne peut que conclure qu'il est très-brillant."

Kremsmünster. Reslhuber. (*Astron. Nachrichten*, 1169, p. 260.)

"Nach mehreren trüben Abenden erscheint der Komet bedeutend heller, einem Sterne dritter Grösse gleich."

The symptoms preceding the formation of the envelopes may be referred to the period between the 11th and 15th of September. The description by Schwabe on the 11th is the first notice which I have met with of a peculiarity in the disposition of the nebulosity on the sunward side of the nucleus, which soon afterwards became a well-marked feature. The Comet was viewed with powerful telescopes at Paris on the 10th and 11th, and at Rome on the 11th, without disclosing the aspect which it presented to Schwabe. The allusion made by the latter to the comets of Halley and Klinkerfues seems to intimate that his

attention may have been directed expressly to it by having witnessed similar phenomena in the case of other comets. Yet it is to be noted that on the 12th we have observations with the great refractors of Cambridge and Poulkova, and also with Lassell's 20-foot reflector, and in neither case is this peculiarity remarked; on the contrary, Struve states expressly that no trace of emissions (Ausstrahlungen) of nebulosity from the nucleus could be discerned. Lassell's sketch resembles Plate XXVII., and has no indication of the outstreaming. On the 13th an indistinctness of outline of the nucleus on the side next the sun was remarked at Berlin, which was probably a precursor of the envelope formation. The evidence on the 14th (Vienna), on the 15th (Cambridge, Eng., and Berlin), and on the 16th (Dorpat and Collegio Romano), becomes more decisive.

1858. September 11. (Plate XLIX. 6.)

PARIS. CHACORNAC. (*Bulletin Obs. Imp. de Paris.*)

"Le 11 septembre, la Comète n'offre rien de remarquable. Son noyau, qui paraît plus brillant que le 10, est observé de nouveau avec les forts grossissements; il présente les mêmes apparences que la veille. Il est comparé photométriquement à la lumière de la chevelure. La partie sud de celle-ci est trouvée plus brillante que la partie nord, et son intensité totale est une fraction minime de l'intensité lumineuse du noyau."

DESSAU. SCHWABE. (*Astron. Nachrichten*, 1165, p. 205.)

"Mit 30 mal Vergr. erschien der Kern scheibenförmig, nur an der dem Schweife zugewendeten Seite scharf begrenzt, und mit einem gelblichen Lichte. Der Schweif war weiss, streifig, etwas nach links im astron. Fernr. gekrümmt und auf seiner rechten convexen Seite heller; sein Licht war veränderlich, bald heller, bald matter. Von der linken Seite des Kopfes im astr. F. ging ein äusserst matter, kurzer Nebenschweif aus, der mit der Axe des Hauptschweifes einen Winkel von 45 bis 50 Grad machte, aber schon am andern Tage verschwunden war, und nicht wieder sichtbar wurde. Mit 96 m. Verg. wurde der Kern kleiner, nach der Sonne zu ging ein Lichtstrom aus, dessen haarförmige Streifen sich bogenförmig zurückkrümmten, und mit dem Schweife sich vereinigten, oder vielmehr ihn bildeten. Hierdurch trat eine Aehnlichkeit mit dem *Halley*-schen und *Klinkerfues*-chen Cometen ein. Mit 144 m. V. war der Kern nur noch ein Punkt, der sich mit 216 m. V. in eine dichte Lichtmasse auflöste."

COLLEGIO ROMANO. SECCHI. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 13.)

"Agli 11 settembre la cometa era già visibile ad occhio nudo e la coda era quale si vede nella fig. . . . (Plate XLIX. 6.), senza che però appaia in essa

nessuna irregolarità dalla parte del sole, e solo il nucleo trovavasi notabilmente eccentrico, l' angolo di posizione della coda 4° 42′ circa."

The figure referred to shows nothing of the phenomenon described by Schwabe.

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 20.)

"20^h 10^m Sternz. Der Kern ist eine gut begränzte planetarische Scheibe, die vielleicht ein wenig heller in der Mitte ist. Durchmesser 7″.47. 2 Beob."

(Ibid., p. 28.)

"20^h 10^m Sternz. $p = 356°.89$. 6 Beob."

1858. September 12. (Plate XLIX. 7, 8.)

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"A rapid increase of brightness and length of tail; the latter covers an arc of 6° in the Comet-seeker, and 4° to the naked eye. The intensity as well as the quantity of light emanating from the nucleus are the most distinctive features. To the naked eye, aided by the light of the envelope and contiguous part of the tail, it was as bright as a star of the third magnitude. In the telescope the light, concentrated within a circle of 10″ diameter, resembles that of a star of the fifth or sixth magnitude, diffused over an equal space. It seems that a portion of the envelope and tail between *a* and *b* is brighter than the rest. (The diagram referred to shows that the apparent right-hand, or north-following side of the head of the Comet and of the tail is intended.) I noticed a similar deviation from symmetry on the morning of the 8th – 9th."

HIGHBURY, ENG. BURR. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 26.)

"The Comet had wonderfully increased in brilliancy. The nucleus was more planetary and discoid in character, of a golden tint, and having the coma or nebulous haze extending round it on one side, and stretching away to a tail of about 3° in length in the opposite direction. There was a well-marked, comparatively dark separation between the nucleus and the exterior outline of the head, and the sides of the tail were more brilliant than the central portions, conveying the impression that the bright nucleus was near the extremity of a nebulous, tubular envelope, with slightly divergent sides, and therefore approximating to a funnel shape. The growth of the tail now became exceedingly rapid; and the brilliancy of the head increased likewise, it being but little inferior to that of the stars composing the tail of *Ursa Major.*"

HADDENHAM, ENG. DAWES. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 88.)

"Sky remarkably clear. Comet found with the equatorial at 6^h 43^m, G. M. T., and was at that time well and easily seen. . . . . . The nucleus appears quite planetary."

OBSERVATORY OF HARVARD COLLEGE. HALL.

"Saw Donati's Comet this morning at half past three o'clock. To the naked eye the nucleus appeared as bright as a star of the second magnitude, and the tail from five to six degrees long."

BRADSTONES, ENG. LASSELL. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 21.)

"The time of observation was 1858, September 12, from 8 to 9 P. M. The Comet was first viewed with the 20-foot equatorial, with a power of 155, having a field of 19′.1 in diameter.

"Nucleus estimated to be .10″ diameter, remarkably well defined. Its appearance reminded me of the disk of the planet *Uranus* in this telescope with a power of 400, when the atmosphere was unfavorable enough to make the edge of the disk soft. A slight bifurcation was suspected at about 10′ from the nucleus, but was not fully ascertained. Breadth of the tail about 12′. Edge of the tail on the side towards which the Comet was advancing obviously brighter than the opposite edge. . . . . .

"The Comet was also viewed with a refractor of 2.6 inches aperture, and power 35, with a field of 76′. . . . . .

"The nucleus in this telescope seemed bright, but rather stellar than planetary."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 2.)

"21^h 30^m. Der Himmel leicht bewölkt, aber der Schweif konnte durch zwei Durchmesser des Suchers verfolgt werden. Aus Ablesungen am Declinationskreise wurde seine Länge 2°.5 gefunden. Der Schweif auf der vorangehenden Seite ein wenig concav ausgebogen und weniger scharf begränzt als auf der nachfolgenden. Der Kern erscheint elliptisch, die grosse Achse auf 6″ geschätzt unter dem Positionswinkel 7°.7, die kleine Achse 3″.5. Keine Spur von Ausstrahlungen am Kern. Abstand des Kerns von der südlichen Begränzung der Nebelmasse zu ein Viertel Feld von Vergr. III. oder zu 1′.7 geschätzt. Auf dem Parallel des Kerns, Breite der Nebelmasse = 0.6 Feld von Vergr. III. oder 4′.0.

"Anmerkung. Die bemerkte Ellipticität des Kerns ist möglicherweise durch seine nur wenige Grade betragende Erhebung über dem Horizonte hervorgebracht. Eine beigefügte Skizze zeigt den Cometen viel mehr in die Länge gestreckt als am 2 September."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 20, 21, 28.)

"Im Sucher ist der Kern fast genau so hell, als ξ Ursæ maj., beträchtlich schwächer als ν Ursæ. Den ersten nennt Argelander 4.3^m, den zweiten 3.4^m. Durchmesser = 7″.29. 4 Beob. Der Kern scheint genau kreisförmig zu sein."

"Scheitelradius der Coma 1′.7."

"20^h 15^m Sternz. $p = 354°.15$. 6 Beob."

1858. September 13.

CAMBRIDGE, ENG. BREEN. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 16.)

"The nucleus beautifully sharp and stellar."

BERLIN. BRUHNS. (*Astron. Nachrichten*, 1161, pp. 137, 138.)

"Die von Herrn Pape angedeutete Unbestimmtheit des Kometkerns nach der der Sonne zugekehrten Seite, wo sich eine Art Ausstrahlung zeigt, wurde hier von Dr. Förster und mir schon am 13^{ten} Sept. bemerkt."

PARIS. CHACORNAC. (*Bulletin Obs. Imp. de Paris.*)

"Le 13 septembre, l'éclat du noyau a été comparé photométriquement à celui d'une étoile de 7^{me} à 8^{me} grandeur. L'intensité lumineuse du noyau et celle de la chevelure de la comète ont été aussi comparées."

BERLIN. FÖRSTER. (*Astron. Nachrichten*, 1205, p. 67.)

"Selbst mit 600facher Vergrösserung noch eine verwaschene Scheibe. In der Richtung 50° wurde eine Verlängerung des Kerns wahrgenommen."

(Ibid., p. 68.)

"Positionswinkel der Schweif-Mitte = 352°.25."

(Ibid., p. 69.)

"Durchmesser des Kerns reducirt auf die Entfernung 1 = 7″.7."

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, p. 310.)

"Sept. 13 sah ich ihn zuerst, jedoch nur bei schwachen Vergrösserungen eines 3½ füss. Fraunhofer. Die kernartige Verdichtung schien mir nichts Auffälliges zu zeigen, sie war nach allen Seiten von einer hellen Coma umgeben, die nach der der Sonne entgegengesetzten Seite in den Schweif überging."

SPALDING, ENG. SELBY. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 27.)

"A sudden and momentary emanation from the nucleus was remarked. At first it was supposed to be due to atmospheric causes; but from its recurring in precisely the same form, the author felt convinced that it was really attributable to a change in the nucleus.

"Appearances of a similar nature continued to be observed during the visibility of the Comet."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 2.)

"19^{h} 40^{m}. Bei höherem Stande des Cometen ist der Kern sehr schlecht begränzt. Was etwa als Kern zu bezeichnen wäre, zeigt keine sichere Abweichung von der Kreisform. Der Durchmesser dieses Kreises ist nur auf 4″ bis 5″ zu schätzen."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 20.)

"19^h 40^m Sternz. Gleich beim Hineinsehen in das Fernrohr erscheint mir die planetarische Scheibe erheblich kleiner, als die Tage vorher, was die Messungen bestätigen. Kern gut begränzt. Durchmesser in der Richtung des Schweifes 4″.03. 4 Beob. Senkrecht auf diese Richtung 4″.43. 4 Beob."

(Ibid., p. 28.)

"20^h 10^m Sternz. $p = 354°.46$. 1 Beob."

1858. September 14.

PARIS. CHACORNAC. (*Bulletin Obs. Imp. de Paris.*)

"Le 14, des observations analogues constatent que la lumière de la portion sud de la chevelure continue d'être plus brillante que celle nord.

"La Comète, examinée dans la grande lunette depourvue de tout oculaire, avec un polariscope Savart, offrait des traces de polarisation sensibles seulement dans la portion de la queue la plus voisine du noyau."

MARKREE. GRAHAM. (*Obs. of Donati's Comet*, 1858, *Markree*, p. 6.)

"The nucleus of the Comet was clear, but ill-defined; about the brightness of a 3d mag. star; tail about five degrees long. A small star was visible through the axis of the tail half a degree from the nucleus."

VIENNA. WEISS. (*Annalen der k. k. Sternwarte in Wien*, F. III. IX. p. 177.)

"Am 14 September gegen Mittag wurde der Comet aufgesucht, konnte aber trotz seines sehr günstigen Standes nahe am Zenith nicht gesehen werden. Abends wurde er um 6^h 32^m m. Z. mit dem 6zölligen Refractor schon sehr gut gesehen. Bei vorgerückter Dämmerung beobachtete ich zum ersten Male die Ausströmung aus dem Kerne; der Glanz des Kernes bei zunehmender Dunkelheit erschwerte die Wahrnehmung des Phänomens."

1858. September 15.

CAMBRIDGE, ENG. BREEN. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 16.)

"A fan-shaped tail to the nucleus, opposite to the tail of the Comet. A sketch exhibited the nucleus round, with two projections turned from the tail, and equally inclined to its axis."

FLORENCE. DONATI. (*Bulletin Obs. Imp. de Paris.*)

"Après la mi-septembre, la queue commença à se montrer partagée en deux, suivant sa longueur. Les deux bandes lumineuses etaient d'inégale épaisseur, et la partie sombre qui les séparait, très-foncée près du noyau, s'éclairait peu à peu en s'en éloignant, et finissait par se confondre avec les parties les plus éloignées et les moins éclairées de bandes claires. Cette division de la queue n'est plus visible à présent (19 octobre)."

BERLIN. FÖRSTER. (*Astron. Nachrichten*, 1205, p. 67.)

"Sehr deutliche Ausströmung nach der Richtung (80°), ebenso der helle Strahl nach der Richtung 50° sehr deutlich."

(Ibid., pp. 68, 69.)

"Positionswinkel der Schweif-Mitte = 352°.57."

"Durchmesser des Kerns reducirt auf die Entfernung 1 = 9″.1."

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, p. 310.)

"Sept. 15 sah ich in demselben Fernrohr die Erscheinung des Cometen ähnlich wie am 13^{ten}. Bei Anwendung stärkerer Vergrösserungen bemerkte ich einen kleinen Kern im Mittelpunct des dichtesten Theils der Coma."

1858. September 16. (Plate XLIX. 9, 10.)

DORPAT. MÄDLER. (*Beob. der Kaiserl. Sternw. Dorpat*, XV. pp. 35, 36.)

"Der Comet erschien mit einen gut begrenzten Kerne, an Helligkeit mit freiem Auge = 2^m geschätzt; Durchm. des Kerns nach Schätzung 5″. Nach der Mitte eine geringe Verdichtung. Der ziemlich gut begrenzte Schweif 6 - 8° lang. Nach der entgegengesetzten Seite aus dem Kopfe heraus eine fächer- oder büschelförmige Ausstrahlung von röthlicher (?) Farbe und merklich heller als die umgebenden Schweiftheile. Der Schweif umgiebt den Kern mit parabolischer Krümmung, und seine Begrenzung um den Apex herum erscheint ganz scharf."

COLLEGIO ROMANO. SECCHI. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 13.)

"Il 16 settembre si videro cominciate le sue fasi più singolari: 'Due getti divergenti di luce partivano dal nucleo, e questi giunti alla piccola distanza di circa un diametro del nucleo medesimo, si ripiegavano indietro bruscamente per andare a formare la coda.' L' apparenza era perfettamente quella di due ciocche di capelli rigidi rovesciati indietro con piegatura quasi angolare: v. fig. . . . (Plate XLIX. 9.) Queste apparenze non sono nuove; è noto che anche la cometa di Halley ne presentò delle simili e può vedersi la figura ne' disegni di Schwabe riportati anche nell' *Astronomia popolare di Arago*, tom. 2, p. 384."

The first notice of the faint external envelope, "Umhüllung," occurs on the 16th by Winnecke at Poulkova. Its faintness and distance from the nucleus caused it to be overlooked by the generality of observers, through the whole apparition.

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 20.)

"Dem blossen Auge macht der Kern den Eindruck eines Sternes, heller als die glänzendsten der beträchtlich höher stehenden Bärensterne. Im Sucher scheint der Kern so ziemlich die Helligkeit von ν Ursæ maj. zu haben, doch ist die Vergleichung ausserordentlich schwierig wegen der grossen Verschiedenheit des zu vergleichenden Lichtes. Oben erscheint er etwas röthlich, wahrscheinlich eine

Folge der Diffraction. Durchmesser, wie immer, wo nicht ausdrücklich das Gegentheil bemerkt ist, in der Richtung des Schweifes $= 3''.46$. 2 Beob."

(Ibid., pp. 21, 22.)

"Das Aussehn des Schweifes und der Coma hat sich nicht unwesentlich verändert. Während früher keine irgend erhebliche Lichtansammlung stattfand, ist heute die folgende Seite des Kopfes bedeutend heller als die vorhergehende. Der Kern ist umgeben von einer sehr hellen Nebelmasse, die in der dem Schweife entgegengesetzten Richtung sich auf etwa $40''$ vom Kerne entfernt, dann umbiegt und den eigentlichen Schweif bildet. Ausserdem bemerke ich eine zweite sehr viel schwächere Umhüllung, die sich etwa $2'.5$ in der Richtung zur Sonne vom Kerne entfernt, und die hellere Nebelmasse umgiebt, so aber, dass sie auf der nachfolgenden Seite erheblich breiter ist, als auf der vorhergehenden. Dort unterscheidet man sie in einigen Minuten Abstand vom Kopfe nicht mehr, während sie hier auf ein halbes Feld der 60f. Vergr. ($13'$) zu verfolgen ist. Siehe Skizze für Sept. 16. (Plate XLIX. 10.) Diese Umhüllung scheint mir in südöstlicher Richtung etwas aufgewulstet zu sein. Im Durchschnitte des Kernes ist die helle Nebelmasse $1'.5$ breit, die schwache aber gegen $4'$.

"22^h 5^m Sternz. Im Cometensucher bemerkt man von diesen Eigenthümlichkeiten des Kopfes Nichts."

(Ibid., p. 28.)

"20^h 50^m Sternz. $p = 354°.77$. 6 Beob."

(Ibid., p. 46.)

"Am 16 Sept. bemerkte ich zuerst, dass der Kopf des Cometen eingehüllt war in eine sehr zarte, bläuliche Nebelmasse, deren Wahrnehmung in Vergleich mit der Sichtbarkeit des hellen Nebelstoffes, der den Kern in parabolischer Form umgab, und den eigentlichen Schweif bildete, Schwierigkeiten machte, so dass ich im Cometensucher an diesem Abende noch Nichts davon bemerken konnte, obgleich ich das Dasein am Heliometer bei schwacher Vergrösserung kurz vorher constatirt hatte. Der äussere Umriss hatte gleichfalls eine parabolische Form; von einer scharfen, bestimmten Begränzung war jedoch keine Rede. In der Richtung zur Sonne entfernte sich die Umhüllung beträchtlich weiter vom Kerne des Cometen, als der helle Schweifnebelstoff, erreichte jedoch den grössten Abstand von demselben nicht in dieser, sondern in einer etwa 30° verschiedenen Richtung, wodurch die Lage zu Kern und Hauptschweif unsymmetrisch wurde. Die Schenkel des Schweifes divergirten stärker, als die der schwachen Umhüllung, so dass jene sich in geringer Entfernung unterhalb des Kopfes schon an den Schweif anschloss

und nicht weiter von ihm zu unterscheiden war, eine Entfernung, die aber vermöge der erwähnten Nichtsymmetrie verschieden war auf den beiden Schweifästen."

1858. September 17.

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"To the naked eye, the head appears as a star of the 2d magnitude. . . . . . The south-following side of the envelope and tail is evidently the brightest."

The Comet was seen also on the 18th, but no other peculiarity was noticed.

DORPAT. MÄDLER. (*Beob. der Kaiserl. Sternw. Dorpat*, XV. p. 36.)

"Messung des Kopfes: 18^h 29′ . . . . . 3″.463.

Um 18^h 30′ Stz. die Ausstrahlung schon sichtbar, doch noch nichts vom Schweife. Für die Richtung der Mitte der Ausstrahlung erhielt ich 182° 30′. . . . . .

"Um 19^h 40^m Richtung der Ausstrahlung 185° 52′; des Schweifs 354° 42′. . . . . .

"Am folgenden Morgen beobachtete ich den Cometen, um die Dauer seiner Sichtbarkeit zu bestimmen, wozu es nöthig ward nach Kr. O. umzulegen.

Messungen des Kopfs: 4^h 45′ . . . . . 3″.566.

Die Ausstrahlung noch schwach sichtbar, doch keine Spuren des Schweifs.

Stz. 5^h 5^m 12^s der Comet schon schwach.
5 15 40 " " kaum noch sichtbar.
5 17 40 Letzter Blick im Moment des ⊙aufganges."

ALTONA. PAPE. (*Astron. Nachrichten*, 1160, p. 127.)

"Schon Sept. 17 glaubte ich bei hinreichend starker Vergrösserung am Kern des Cometen eine gegen den Scheitel der Coma gerichtete Verlängerung zu bemerken."

(Ibid., 1172, p. 310.)

"Sept. 17 betrachtete ich den Cometen gemeinschaftlich mit Herrn *Paschen* in Schwerin bei verschiedenen Vergrösserungen eines 4½ ff. Fraunhofer. Es schien mir, als ob am Kern (im umkehrenden Fernrohr) etwas nach links von der Richtung zum Scheitel der Coma eine Verlängerung in Gestalt einer kleinen Ausströmung sichtbar sei. Jedoch war die Aufstellung des Fernrohrs nicht hinreichend fest, um mit Ruhe die Erscheinung auffassen zu können. Die Richtung der Ausströmung mochte etwa 10° nach links von der Richtung zum Scheitel der Coma geneigt sein."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 2.)

"20^h 0^m. Der Kern auf 3″ – 4″ im Durchmesser geschätzt, kreisrund aber nicht sehr bestimmt. Abstand des Kerns von der Spitze des Nebels, kaum 0′.5, aber ein schwächerer Nebeldunst, etwas länglich in der dem Schweif entgegengesetzten

Richtung, bis auf 3′ Abstand vom Kern erkannt. Letzteres war schon von mir am Abend vorher an einem dreifüssigen Münchener Fernrohr bemerkt. Der Schweif auf der vorangehenden Seite viel schwächer und unbestimmter als auf der nachfolgenden; in der Mitte zwischen den beiden Schweifhälften entschieden dunklerer Zwischenraum, der nur mit schwacher Nebelmasse gefüllt zu sein scheint."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 22.)

"Auch heute ist die nachfolgende Seite des Kopfes die hellere.

Länge des Scheitelradius der hellern Nebelmasse 25″, Breite im Durchschnitt des Kernes 1′.3.

Länge des Scheitelradius der schwachen Nebelmasse 3′.5, Breite im Durchschnitt des Kernes 4′.

"Es bezog sich so rasch wieder, dass der Durchmesser des Kernes nicht gemessen werden konnte."

(Ibid., p. 29.)

"20^h 0^m	Sternz. p =	355°.70.	2 Einst.
0 15	"	355 .80.	6 Einst.

"Es bezog sich nach den beiden ersten Einstellungen völlig, wurde aber später wieder heiter, so dass eine neue Messungsreihe anzustellen möglich war."

1858. September 18. (Plate XLIX. 11.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs,* 1858, p. 212.)

"Foruden en almindelig, temmelig jevn fremskridende Tiltagen i Kometens Glands og synlige Stœrrelse, iagttoges der heller ikke paa denne Aften nogen synderlig Forandring, og denne Paastand strider ikke mod de af Andre derom fremsatte Bemærkninger, hvorefter det vel bœr ansees for afgjort at der fœr den 21 September aldeles Intet tydede paa den særegne Udvikling, som Kometen senere undergik. Fœrst fra den Tid af daterer sig den vigtige Epoche i denne Komets eiendommelige Omdannelsesrække. (Cfr. *G. P. Bond,* Account of Donati's Comet, Cambridge, 1858, pag. 10; *Peters* og *Pape* i Astron. Nachr. Nr. 1160, p. 127 og fl. a St.)"

MARKREE. GRAHAM. (*Obs. of Donati's Comet,* 1858, *Markree,* p. 6.)

"Nucleus appeared somewhat elongated. Light of Comet much stronger on the east or following side."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 3.)

"18^h 50^m – 20^h 10^m. Der Kern erscheint bei heller Dämmerung, trotz seines niedrigeren Standes, dem blossen Auge heller als α Ursæ Maj.

"Am Kern erscheint, erheblich heller als der übrige Comet, ein fächerförmiger

Ansatz, durch den sich in zwei Richtungen hellere Lichtstreifen durchziehen. Abwechselnd mit Vergr. II. und IV. wurden folgende Schätzungen erhalten:

Durchmesser des Kerns 2″.

Abstand, Kern bis Spitze des Cometen 25″.

Breite der Nebelmasse auf dem Parallel des Kerns 1′.5.

" " bei 4′ Abstand vom Kern 3′.0.

Richtung der hellsten Ausstrahlung im Fächer 221°.

Ausdehnung derselben 12″.

Nächst helle Ausstrahlung in der Richtung 142°.

Richtung der äussersten Spitze des Fächers

auf der vorangehenden Seite 246°.

" nachfolgenden Seite 112°.

Entfernung der Spitzen vom Kern 8″.

"In der Entfernung einer Minute vom Kern beginnt die Theilung des Schweifs.

"Die schwache nach Süden gerichtete Nebelhülle hatte ihre grösste Ausdehnung von ungefähr 3′, in der Richtung 162°. Auf dem Parallel des Kerns war sie 4′ breit, wovon 1′.5 auf die vorangehende Seite, 2′.5 auf die nachfolgende fallen."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 20.)

"D = 1″.63. 3 Beob. bei ruhiger und schöner Luft. Der Kern erschien heute so klein dass ich den vierfachen Durchmesser mass, eine Methode, deren Anwendbarkeit Messungen der Jupitersatelliten zeigen, die ich auf diese Weise am Bonner Heliometer ausgeführt habe. Die Begränzung desselben war vortrefflich; der Durchmesser sicher grösser als die Scheibe der hellen Bärensterne."

(Ibid., p. 22.)

"19^h 30^m Sternz. Das Aussehen des Cometen ist überraschend, vergl. die Figur für heute. (Plate XLIX. 11.) Die rechte Seite ist viel heller; während die grössere Helligkeit rechts ziemlich stetig schwächer wird, je mehr man sich vom Kerne entfernt, hört sie links eine oder anderthalb Minuten unter dem Kerne fast plötzlich auf.

Den Abstand der hellern Nebelmasse v. Kerne in der Richtung des Schweifes, schätze ich zu 20″.

Den Abstand der schwachen Nebelmasse v. Kerne in der Richtung des Schweifes, schätze ich zu 2′.7.

In der hierauf senkrechten Richtung durch den Kern, Breite der hellen Nebelmasse 1′.5.

In der hierauf senkrechten Richtung durch den Kern, Breite der schwachen Nebelmasse 5′.5."

(Ibid., p. 29.)

"20^h 10^m Sternz. $p = 356°.31$. 6 Beob."

1858. September 19.

PARIS. CHACORNAC. (*Bulletin Obs. Imp. de Paris.*)

"Le 19 septembre, l'aspect de la Comète a un peu changé. La lumière de la chevelure devient plus intense sur les parties nord et sud, et la partie sud conserve une prédominance.

"Le noyau offre un diamètre plus apparent, qui paraît, même avec les plus faibles grossissements, entouré d'une petite nébulosité sensiblement plus étendue dans le sens opposé à la queue. Observé avec le grossissement de 770 fois, le noyau ne perd plus aussi complètement son aspect planétaire.

"La partie tournée vers le soleil paraît être la plus nébuleuse.

"Le noyau n'occupe pas le centre de la chevelure; il est plus rapproché de la limite nord que de la limite sud. Mais les contours de cette chevelure sont trop mal definis pour qu'on puisse mesurer cette différence.

"La partie la plus lumineuse du noyau est comparée photométriquement à l'étoile la plus brillante de la constellation des Lévriers; elle est trouvée à peu près égale en éclat à la plus faible des deux composantes de cette étoile double. L'éclat du noyau est ensuite comparé à celui de la chevelure et notamment à la partie moins lumineuse placée dans l'axe de la queue.

"La Comète est de nouveau examinée avec la lunette armée d'un polariscope; mais la quantité de lumière polarisée est trop faible pour que les traces de polarisation soient nettement accusées par l'appareil."

DORPAT. MÄDLER. (*Beob. der Kaiserl. Sternw. Dorpat,* XV. pp. 36, 37.)

"Sogleich nach Untergang der Sonne zeigte sich der Cometenkopf in voller Deutlichkeit. Der Durchmesser des Kopfs gemessen, bevor die Ausstrahlung sichtbar war, 18^h $22'$. . . . . . $3''.491$. Nach 20-25 Minuten schien der Kopf merklich grösser zu sein.

"Die Ausstrahlung erschien zuerst gegen 18^h $40'$; der Schweif erst später. Erstere umfasste heut (vom Cometenkopfe ausgenommen) 190° bis 200°, und beide Grenzen gegen den Schweif zu scharf abgesetzt, weniger scharf die äussere Umfangslinie die parabolisch gekrümmt erschien.

Richtung der Ausstrahlung:	18^h $53'$.	159° 37'.3.
" "	19^h $20'$.	156° 30'.7.
" "	20^h $44'$.	154° 43'.0.
Richtung des Schweifes um	19^h $0'$.	353° 2'."

Poulkova. Winnecke. (*Pulk. Beob. des Grossen Cometen* 1858, p. 20.)

"D = 2″.60. ·2 Beob. Luft ziemlich unruhig.

"Es wurde heute wieder der vierfache Durchmesser gemessen, so wie von jetzt an immer. Der Kern scheint mir ganz rund zu sein und ist ziemlich gut begränzt."

(Ibid., p. 22.)

"Zu einer beiläufigen Skizze ist nur notirt: der Raum in der Mitte zwischen den beiden Schweifästen in heller Dämmerung sehr schwach."

(Ibid., p. 29.)

"19^h 35^m Sternz. $p = 356°.47$. 6 Beob."

Up to this date I find no positive recognition of the regular envelope formation, which became, within a few days, the most notable and characteristic feature in the telescopic view of the Comet. The outer veil or envelope (Umhüllung) was remarked by Winnecke on the 16th of September, and subsequently by himself and a few other observers. This, however, was so peculiar in its position, faintness, and dimensions, that, for the present at least, and until its connection with the inner envelopes be more clearly understood, it may be classed as a distinct phenomenon.

There is sufficient evidence to show that the emission of nebulosity from the sunward side of the nucleus, faintly indicated between the 11th and 15th, had gradually assumed more prominence and decision. On the 18th the direction and extent of the principal jets were measured by Struve, but the clearly defined exterior margin of the sector on the side next the sun, enclosing with a regular and continuous curve all the streams issuing directly from the nucleus, seems not yet to have made its appearance. The suddenness with which the phenomena of the completely formed envelopes were developed between the 20th and the 23d of September deserves particular attention. It suggests the idea of a cloud deposition in an atmosphere as the most suitable illustration of the great change of aspect which took place *in situ* during this short interval. Subsequently to the latter date there was less to force such an explanation upon the mind, the phenomena, though equally marked, being to appearance not inconsistent with such changes as a gradual elevation and diffusion of material thrown off from the nucleus might be supposed capable of producing.

The following account is the earliest mention of the dark arc limiting the envelope on the side presented towards the sun. It was next seen on the 22d at Rome, on which date also the definite outer margin of this envelope is indicated in Winnecke's figure.

1858. September 20. (Plates XXVIII. and XLIX. 12, 13.)

Observatory of Harvard College. G. P. Bond.

"The tail was plainly bifurcated near the nucleus, and the following side was so much the more brilliant of the two, that in strong twilight this alone would have been seen as a short tail, inclined by 30° or more to the true axis. Between the nucleus and the sun is interposed an obscure crescent outline, within which the light is unequally distributed, and has a strangely confused chaotic look; the details are too undecided for precise description. There is also an elongation of the nucleus, which is singularly brilliant, or perhaps a ray (in the sketch, more nearly resembling a little wisp attached to the right side of the nucleus) extending a few seconds from it on the following, or upper side." A sketch made at the time shows the dark crescent extending through an arc of 145° measured from the nucleus. Its distance from the latter at the vertex was 22″.5, measured from the sketch, probably quite uncertain.

A memorandum on the side of the sketch, alluding to the dark outline, — "Perhaps the lunule is an illusion," — shows that it was, at all events, not seen without difficulty, although fully confirmed on the next date of observation. This remark is not without importance, as a reference to subsequent observations will prove. The ray from the nucleus and the dark crescent are indicated on Plate XXVIII. The ray or elongation of the nucleus may have been an intimation of a second envelope.

Markree. Graham. (*Obs. of Donati's Comet* 1858, *Markree*, p. 6.)

"The S. side of the nucleus faded off gradually into the coma, without any defined boundary line; the N. and N. E. pretty well defined. The nucleus seemed to stretch out to the westward or preceding side, at an angle of about 120 degrees with the tail, giving a rough idea of a cusp. There was a similar appearance towards the E. in the continuation of the line, but not so well marked. Southward of a line touching the nucleus on the N. side, and making an angle of about 60° with the axis of the tail on the E. side, the light was decidedly stronger than on the other side of this line. The entire view impressed us with some such idea as Venus would present when a little more than half illuminated, and when seen very near the horizon with bad definition. The light of the tail was pretty uniform throughout the entire breadth for about twice the diameter of the nucleus northward; thence it parted into two rays, the upper one (N. E.) being the brighter and broader."

Dorpat. Mädler. (*Beob. der Kaiserl. Sternw. Dorpat*, XV. p. 37.)

"Starke Bewölkung bei unruhiger Luft liess wenig wahrnehmen. Um $19^h\ 0'$

bestimmte ich die Richtung der Ausstrahlung, die heut eine bestimmt röthliche Färbung zeigte, in einer Messung zu 145° 42′. Die Schweifspuren zu schwach."

ALTONA, PAPE. (*Astron. Nachrichten*, 1160, p. 127.)

"Sept. 20 sahen Herr Professor *Peters* und ich übereinstimmend eine vom Kern des Cometen ausgehende Ausströmung, die der Richtung des Schweifes entgegengesetzt war. Der Kern war nämlich, gegen den Schweif zu, scharf begränzt in einem Umfange von etwa 240°; dagegen in der Richtung zur Coma zeigte er sich in einer Ausdehnung von nahe 120° verwaschen, so dass es das Ansehen hatte, als ob in dieser Richtung die Materie, welche den Kern bildete, allmälig in die Coma und dann, rechts und links abbiegend, in den Schweif überströmte. Die Richtung dieser Ausströmung bildete mit der verlängerten Richtung des Schweifes einen Winkel von etwa 30° nach rechts (im astronomischen Fernrohr)."

(Ibid., 1172, p. 311.)

"Am 20sten Septbr. sah ich den Cometen auf der hiesigen Sternwarte bei stärkeren Vergrösserungen des 4ff. Fraunhofer. Die am 17ten gesehene Erscheinung war weit auffälliger geworden. Vom Kern aus strömte, nahezu in der Richtung gegen die Sonne, eine helle Lichtmaterie in die Coma über. Der Winkel, welchen die Ränder dieser Ausströmung am Kern einschlossen, betrug etwa 120°. Auf der dieser Ausströmung entgegengesetzten Seite war der Kern scharf abgegrenzt, und von einem dunklern Raum umgeben. Die letztere Erscheinung ist mir am 17ten nicht aufgefallen, während sie heute nicht zu übersehen war. Die Mittellinie der hellen Ausströmung schien Herrn Prof. *Peters* und mir etwas nach rechts von der Verlängerung der Schweifaxe geneigt zu sein; der Winkel mochte 30° betragen. Ich muss noch hinzufügen, dass mir die Ausströmung ohne bestimmte Grenzen erschien, und dass sie allmälig mit abnehmender Helligkeit vom Kern aus in die Coma überging."

COLLEGIO ROMANO. SECCHI. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 13.)

"La sera del 20 il nucleo fu trovato essere 6″.0."

1858. September 21.

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 212.)

"Lysudstrœmningen fra Kjærnen var rimeligviis allerede samme Aften begyndt; da jeg imidlertid ikke blev opmærksom derpaa, og saaledes ikke heller fandt Anledning til efter endt Observation med stærkere Oculare at undersœge Kjærnen, kan den vel neppe have været meget kraftig og levende."

CAMBRIDGE, ENG. BREEN. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 16.)

"The nucleus like a star of the first magnitude."

HIGHBURY, ENG. BURR. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 26.)

"The light of the head exceeded any star in Ursa Major, and closely approached that of Procyon."

BERLIN. FÖRSTER. (*Astron. Nachrichten*, 1205, p. 67.)

"Die Ausströmung nach oben sehr lebhaft, am hellsten ein Strahl, der in ungefähr 100° Positionswinkel vom Kern ausging und sich schnell krümmte, um den hellsten Streifen der rechten Seite des Schweifes zu bilden. Der Kern links oben etwas schärfer beleuchtet."

(Ibid., p. 69.)

"Erhielt ich, bei sehr tiefem Stande eine unsichere Messung (des Kerns) die offenbar zu gross, 9″.5 ergiebt." (Probably reduced to the unit of distance, as in other measurements by the same observer.)

MARKREE. GRAHAM. (*Obs. of Donati's Comet* 1858, *Markree*, p. 7.)

"Appearance pretty much the same as last night. The angle made by the line which I have regarded as the N. limit of the phase, or that uniting the two cusps with the axis of the tail, is not quite so small as 60°; about 75° is a more correct estimate. . . . . . The nucleus seems to be spheroidal, with the longer axis in the direction of the tail."

DORPAT. MÄDLER. (*Beob. der Kaiserl. Sternw. Dorpat*, XV. p. 38.)

"Gewölk verhinderte die Sichtbarkeit bis ½ Stunde nach Sonnenuntergang. Starker Wind, und nach 8½ Uhr Trübung.

Durchmesser des Kopfs	18^h 34′	3″.487.
Richtung der Ausstrahlung	19^h 39′	146° 53′.3.
" "	20^h 22′	145° 36′.0.

"Für die Richtung des Schweifs (etwas unsicher wegen schon beginnender Trübung) um 20^h 26′ . . . . . 359° 32′."

ALTONA. PAPE. (*Astron. Nachrichten*, 1160, p. 127.)

"September 21 zeigte sich dieselbe Erscheinung, nur schien uns die Neigung nach rechts etwas stärker zu sein, so dass der Winkel zwischen der Richtung der Ausströmung und der verlängerten Schweifaxe etwa 45° betrug."

(Ibid., 1172, p. 311.)

"Der folgende Abend, Sept. 21, liess keine wesentliche Veränderung gegen gestern wahrnehmen. Die Ausströmung war ganz ähnlich, ihre Neigung nach rechts etwas stärker geworden, so dass die Richtung ihrer Mittellinie mit der Verlängerung der Schweifaxe einen Winkel von etwa 45° bildete.

"Auffallend war es jedoch dass die Helligkeit der Ausströmung zugenommen hatte, ohne dass ich den Grund hierfür in grösserer Durchsichtigkeit der Luft

suchen kann, und dass, wie es mir schien, die linke Seite heller war als die rechte; ein Umstand, der die Schätzung der Mittellinie unsicher machte. Ich muss jedoch erwähnen, dass Herr Prof. *Peters* den mir auffälligen Unterschied der Helligkeit nicht so deutlich wahrnahm."

In the following passage is an allusion — perhaps the earliest — to the dark channel immediately in the rear of the nucleus. Its appearance so nearly simultaneously with that of the envelopes deserves note.

Dessau. Schwabe. (*Astron. Nachrichten*, 1165, p. 207.)

"Sept. 21. Mit 96 m. V. sah ich den Kopf nach der (im astr. F.) rechten Seite hin leicht eingedrückt, so dass ein etwas schiefer Scheitel entstanden war, der rechts flacher aber heller erschien. Der Kern besass eine fast halbmondförmige Gestalt und war nach der Sonne hin verwaschen; von hieraus gingen mehre deutlich gekrümmte Strahlen aus; dicht an seiner convexen, nach dem Schweife zugekehrten Seite, zeigte sich in diesem eine sehr dunkle schattenartige Stelle."

1858. September 22. (Plate XLIX. 14, 15, 16.)

Berlin. Bruhns. (*Astron. Nachrichten*, 1205, p. 71.)

"Sept. 22 sah ich ihn (den Cometen) am Refractor mit 90facher Vergrösserung als ein planetarisches Scheibchen ohne scharfe Grenze, etwa 20″ Durchmesser haltend, um 6^h 13′, also 14′ nach Sonnenuntergang."

Markree. Graham. (*Obs. of Donati's Comet* 1858, *Markree*, p. 7.)

"Nucleus more sharply defined, and more planetary than hitherto. At times it appeared quite round; sometimes elliptic, — the major axis of the ellipse being nearly at right angles to the axis of the tail; more exactly, at an angle of 105° westward, with the N. portion of the tail. The coma S. of nucleus seemed somewhat broader. The S. part of the nucleus has been of a light brown color each night, and in all the positions in the field of view that we have examined it."

Dorpat. Mädler. (*Beob. der Kaiserl. Sternw. Dorpat*, XV. p. 38.)

"Der Comet ward 2 Minuten vor Sonnenuntergang gefunden und eingestellt."

Altona. Pape. (*Astron. Nachrichten*, 1160, p. 128.)

"Sept. 22 war die Ausströmung noch deutlicher als an den beiden vorhergehenden Abenden. In heller Dämmerung, als vom Schweif keine Spur zu sehen war, zeigte sich die Ausströmung sehr deutlich, und etwas später, als ein Theil der Coma und des Schweifes sichtbar wurde, hatte der Comet eine täuschende Aehnlichkeit mit einer der Zeichnungen, welche *Heinsius* vom Cometen von 1744 gegeben hat. Die Richtung der Ausströmung schien an diesem Abend sowohl Herrn Prof. *Peters* wie mir genau mit der verlängerten Axe des Schweifes zu-

sammen zu fallen; sie war also seit Sept. 21 um einen halben Quadranten nach links gerückt. Der Schweif war (im astr. Fernr.) an der rechten Seite so erheblich heller als links, dass in der Dämmerung zuerst nur die rechte Seite sichtbar war. Auch war an diesem Abend die Theilung des Schweifes in zwei parallele Äste besonders auffällig."

(Ibid., 1172, p. 311.)

"Bei ungewöhnlich heiterm Himmel stellte ich den Cometen 6^h 15^m m. Z. am $3\frac{1}{2}$ ff. Aequatoreal ein und sah ihn sogleich. In der hellen Dämmerung war nur der feine scharf begrenzte Kern und die Ausströmung bis auf etwa 20″ vom Kern sichtbar. Ihre Figur war die eines Sectors von 120° bis 140°, ihre Grenzen jedoch waren durchaus unbestimmt und verwaschen. Um 6^h 35^m waren die helleren Theile der Coma und des Schweifes sichtbar geworden. . . . . .

"Die Ausströmung war ausserordentlich hell, besonders an der linken Seite, während sie rechts mehr verwaschen erschien. Die Richtung war seit gestern nach links gerückt; sowohl Herr Prof. *Peters* wie ich schätzten dieselbe nahe gleich mit der Richtung der verlängerten Schweifaxe."

DESSAU. SCHWABE. (*Astron. Nachrichten,* 1165, p. 207.)

"Mit 96 und 144 m. V. war der Kern fächerartig ausgebreitet und etwas nach der (im astr. F.) rechten Seite des Kopfes gerichtet. Der Fächer zeigte mehre hellere Strahlen, die ein Mitbeobachter nur auf dieser rechten Seite deutlich erkennen konnte."

The following is the second mention of the dark arc bounding a bright envelope; beyond it a second envelope is now first recognized.

COLLEGIO ROMANO. SECCHI. (*Mem. dell' Osserv. del Coll. Romano,* 1859, p. 13.)

"Ai 22 settembre la scriminatura si trovò svanita perchè oltre i due piccoli raggi di luce detti poc' anzi se ne erano formati moltissimi altri che componevano una specie di ventaglio, dell' apertura di 160° circa. Questo era circondato da un arco più oscuro, al quale succedeva un alone o semicerchio di nebulosità più lucida i cui estremi prolungandosi indietro andavano a formare la coda."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen,* 1858, p. 22.)

"Der Kern schien heute eine fächerartige, breite Ausstrahlung zu haben (vergleiche die Figur für Sept. 22 [Plate XLIX. 15]); es bewölkte sich aber so rasch, dass nichts Sicheres ermittelt werden konnte. Heller Mondschein und Dämmerung."

(Ibid., p. 20.)

"19^h 15^m Sternz. D $= 2''.31$. 2 Beob. Luft sehr unruhig."

The decision and character which the phenomena of the envelopes acquired in the short interval between the 20th and the 23d are very well worthy of atten-

tion, particularly the fact, which seems indisputable, that they at this time came into view ready formed, as it were, without exhibiting the intermediate stages of development, by a gradual rising from the surface of the nucleus, which was the process invariably followed by those succeeding them.

Besides the exterior nebulosity of the head, two were now seen with perfect distinctness at the Observatory of Harvard College, where a feeble outline of but one only was discernible on the 20th. Four are mentioned by Chacornac, but it does not appear whether, or not, one of these was the exterior nebulosity.

To avoid confusion and repetition in the history of the envelopes, the following notation will be used to designate three points in their outer margins; one at the vertex where the outline is intersected by the axis of the tail prolonged through the nucleus, and one on either side of the nucleus at the points of intersection by a line drawn through the latter at right angles to the axis of the tail. The envelopes will be designated by the letters *A*, *B*, *C*, &c., in the order of their succession, so far as this can be ascertained, beginning with the first of which we have a definite description, viz. that of September 20th. Chacornac's observations on September 23d seem to have included one envelope, if not two, preceding *A* in order of succession, but their history cannot be recovered.

Envelope *A*. Outline $a\,a'\,a''$ first seen September 20th. Its vertex, a', was already 22″.5 above the nucleus, by an uncertain estimate. a is on the side preceding in right ascension, a'' on the following or bright side.

Envelope *B*. Outline $b\,b'\,b''$. It was distant on the 23d, 13″ or 14″.

Envelope *C*. Outline $c\,c'\,c''$. Adhering close to the nucleus, September 24th and 25th.

Envelope *D*. Outline $d\,d'\,d''$. Made its appearance in contact with the nucleus between October 2d and 4th.

Envelope *E*. Outline $e\,e'\,e''$. Appeared between October 8th and 9th.

Envelope *F*. Outline $f\,f'\,f''$. Appeared on or a little before October 15th.

Envelope *G*. Outline $g\,g'\,g''$. Forming on October 20th.

1858. September 23. (Plates XXIX. and XLIX. 17, 18.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 213.)

"Som det vil sees af den vedfœiede Tegning, stod den Diameter, som i Aften dannede Segmentets Basis, ingenlunde lodret paa Halens Axe, eller rettere sagt paa en Linie, dragen fra Kjærnen til Halens Toppunkt, men dannede med samme

snarere en Vinkel paa 60 til 65 Grader. Halens Œstrand, som sædvanlig ganske iœinefaldende skarp, i stik Modsætning til det svage, blide og udvaskede Omrids af den venstre vestlige Rand."

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"A fine clear sky with the moon just past the full. To the naked eye the head of the Comet is as bright as a star of the first magnitude, and the train, notwithstanding the moonlight, may be traced 5° or 6°, and at times 2° or 3° farther. It is already a brilliant object half an hour after sunset. Saw at the first glance with the great refractor a most extraordinary exhibition in the nebulosity surrounding the nucleus. The nucleus has diminished in size, being now only 3″ in diameter. Its light is exceedingly intense, and somewhat more concentrated than on the 20th. Outside of it is a bright envelope, bounded on its outer margin by a dark band, 15″ distant. The boundary of a second and less brilliant envelope is distant, at its vertex, about 30″ from the nucleus; it is terminated by a similar dark arch, outside of which again is an atmosphere of faint diffused nebulosity, rapidly shaded off. The outlines can be distinguished through an arc of 220° or more, reckoned from the nucleus, but they extend considerably farther into the train on the following or bright side."

PARIS. CHACORNAC. (*Bulletin Obs. Imp. de Paris.*).

"Le 23 7bre l'aspect de la comète présentait un phénomène remarquable; le noyau était enveloppé de trois demi-cercles concentriques et d'intensités lumineuses différentes. Deux de ces enveloppes, les plus brillantes, étaient traversées par des rayons correspondants et alternativement lumineux et sombres.

"Le noyau n'occupait pas tout-à-fait le centre de figure des enveloppes. Il était plus rapproché de leur limite nord que de celle du sud. La première de ces limites était toujours la moins lumineuse.

"Enfin, très-près du noyau, on observait une quatrième enveloppe plus lumineuse encore que les précédentes et qui semblait se dégager de celui-ci sous la forme d'une spirale.

"Des mesures d'intensités comparatives ont été prises entre le noyau et les enveloppes lumineuses. Les grandeurs du demi-diamètre du noyau et des enveloppes ont été mesurées en tout sens, et seront publiées ultérieurement."

FLORENCE. DONATI. (*Bulletin Obs. Imp. de Paris.*)

"Le 23 Septembre, le noyau de la comète paraissait tout-à-fait rond, et assez bien défini, même avec les forts grossissements. Sa lumière pouvait être comparée à celle de Mars."

snævre en Vinkel paa 60 til 65 Grader. [illegible] som sædvanlig ganske paafaldende skarp, [illegible] og udvaskede Omrids af den venstre vestlige Rand."

Observatory of Harvard College, [illegible]

"A fine clear sky [illegible] To the naked eye the head of the Comet is as bright as a star of the first magnitude, [illegible] train, notwithstanding the [illegible] and at times [illegible] It is already a [illegible] half an hour after sunset. Saw at the first glance with the great [illegible] a most extraordinary exhibition in the nebulosity surrounding the nucleus. The nucleus has diminished in size, being now only 3″ in diameter. Its light [illegible] and somewhat more concentrated than on the 20th. [illegible] bounded on its outer margin by a dark [illegible] of a second and less brilliant envelope is distant [illegible] it is terminated by a similar dark [illegible] of faint diffused nebulosity, rapidly [illegible] through an arc of 220° or more, [illegible] considerably farther into the train on [illegible]."

[illegible]

[illegible] phénomène remarquable; le [illegible] et d'intensités lumineuses différentes. [illegible] brillantes, étaient traversées par des rayons correspondants [illegible] lumineux et sombres.

[illegible] au centre de figure des enveloppes. Il était [illegible] du sud. La première de ces [illegible]

[illegible] quatrième enveloppe plus lumineuse [illegible] de celui-ci sous la forme d'une [illegible]

"Des mesures [illegible] entre le noyau et les enveloppes lumineuses. [illegible] du noyau et des enveloppes ont été [illegible] publiées ultérieurement."

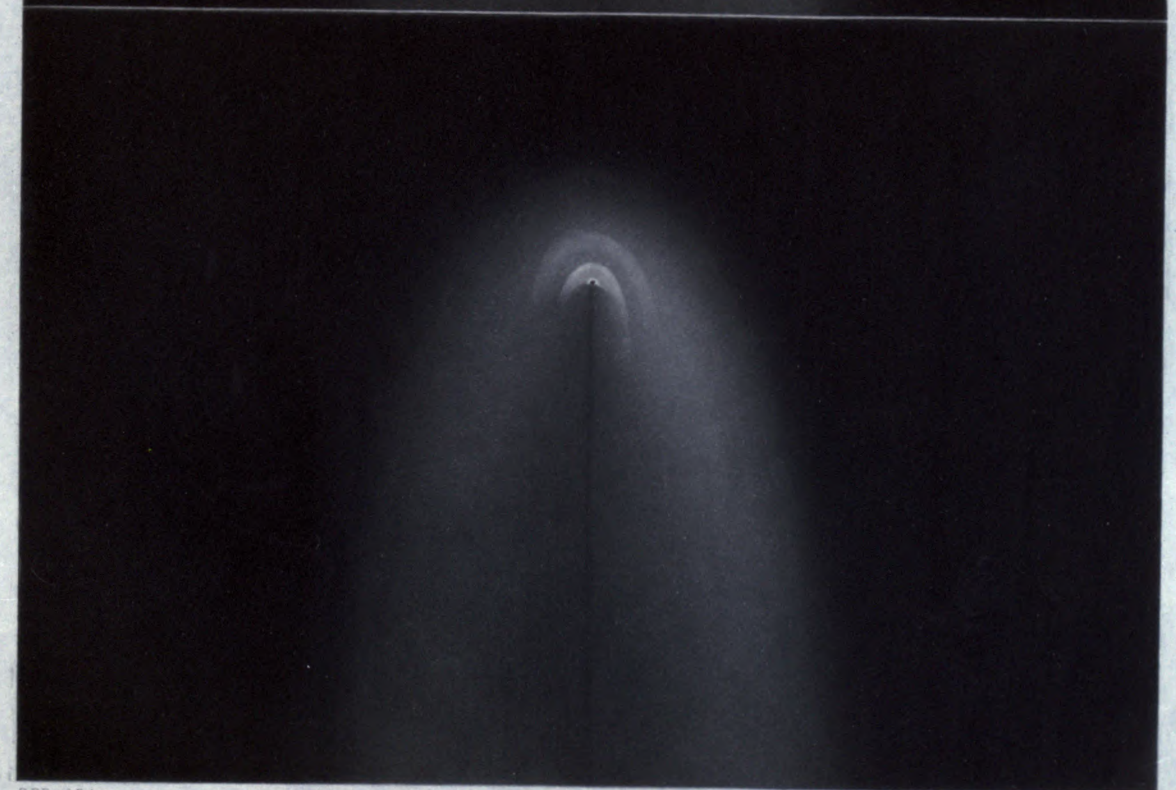
Florence. [illegible]

"Le 23 Septembre, le noyau de la comète paraissait tout-à-fait rond, et assez bien défini, même avec les forts grossissements. Sa lumière pouvait être comparée à celle de Mars."

PLATE XXIX.

COMET OF DONATI 1858.

SEPTEMBER 23RD 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE.



G.P. Bond Del.

J. W. Watts Sc.

COMET OF DONATI 1858.

SEPTEMBER 24TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE.

PLATE XXX.

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DORPAT. MÄDLER. (*Beob. der Kaiserl. Sternw. Dorpat*, XV. p. 39.)

"Messung der Ausstrahlung: 21^h 30^m . . 145° 10′.
Richtung des Schweifs zunächst am Kopfe: 21^h 35^m . 1° 44′."

The increased brightness of the envelopes towards their outer edges, and their alternation with dark arcs, by which they are somewhat sharply terminated on the outside, are conspicuous features on the 24th.

1858. September 24. (Plates XXX. and XLIX. 19, 20, 21, 22.)

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"The direction of the tail at the nucleus is nearly that of a circle of right ascension. The dark arc outside of $b\,b'b''$ can be traced through an amplitude of about 270°. The region within it and south of the nucleus is twice as bright as that outside of it. The light outside of $a\,a'a''$ is quite feeble and diffuse. The bifurcation of the tail is distinct; the outline of the central darkness is parabolic and is well defined, the vertex touching the nucleus. The latter is elongated, in a direction perpendicular to the axis of the tail. Taken as a whole, the head of the Comet is rather pointed, although the contour of the envelope B, which is very bright, is much like the arc of a circle on the side south of the nucleus. The dark arc next outside of C is scarcely more than a darkish space in front of the nucleus."

A sketch is annexed, showing the dark arcs extending, especially on the right-hand (following) side, far down into the tail, and light radiating from the nucleus towards the sun within $c\,c'c''$.

The following measurements were taken:—

Diameter of the nucleus, ...	2″.5
Nucleus to middle of dark space in front of it, . . .	5 .9
" " " arc in front of b', . . .	15 .6
" " " " " a', . . .	34 .1
Distance apart of middle of dark arcs outside of b and b'',	43 .0
" " " " " " a and a'',	75 .7

The breadth of the dark arcs was 3″ to 4″.

The measures in the directions $a\ a''$ and $b\ b''$ were always difficult, because the tangents to the envelopes at these points were not at right angles with the line drawn through the nucleus.

Plate XXX. shows the little inner envelope C too distinctly as to its outline, and the dark arcs are not perhaps decided enough.

CAMBRIDGE, ENG. BREEN. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 16.)

"'Comet very brilliant; nucleus well defined; the luminous sector well seen and

brightest at the edges.' A sketch represented the nucleus as nearly round, surmounted by a luminous sector, which on the side towards the tail was bounded by two arcs tending to form a cusp at the nucleus, and on the other side by a semicircular arch, brighter than the space between it and the nucleus. The coma extended beyond this arch, and in the direction of the tail was considerably fainter near the axis than at the sides."

HADDENHAM, ENG. DAWES. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 88.)

"Visible in the finder of the equatorial at 6^h 10^m. The arc or sector round the southern or *sunward* side of the nucleus is finely seen to-night, though the sky is not perfectly free from haze. I cannot trace the arc round on the side opposite to the sun; it seems to come to a rather abrupt termination at about 40° beyond a semicircle, being visible to about that extent farther into the tail on the eastern side than on the western. It looks like a *hood* set on awry, the tail resembling a fine gauze veil dependent from it. The narrow dark channel extending from the nucleus up to the axis of the tail is very remarkable; its edges are surprisingly well defined, especially very near the nucleus. The comparatively sharp definition of the eastern edge of the tail contrasts strikingly with the softness of outline on the western side.

"There is a second arc very close to the nucleus, and rather bright, and I think nearly uniformly so throughout its extent. The larger sector, on the contrary, is decidedly brighter towards its outer edge, and terminates rather sharply for such an object. A soft nebulosity or coma surrounds the larger arc, and appears to be concentric with it. Its outline is certainly not continuous with that of the tail, the apex of which falls *within* the arc of the sector.

"By measurement of a careful sketch, the middle radius of the sector (drawn from the nucleus to the middle of the arc) makes an angle with the direction of the dark channel in the tail, of about 156°, reckoned round by the *east* side."

A drawing from the sketch referred to (Plate XLIX. 22) has been communicated to me by Mr. Dawes.

DORPAT. MÄDLER. (*Beob. der Kaiserl. Sternw. Dorpat*, XV. p. 39.)

"Die Ausstrahlung zeigt heut keine scharfe Begrenzung, ist überhaupt viel matter als früher. Doch war der Unterschied gegen den Schweif noch immer erheblich genug, um die Richtung bestimmen zu können.

Ich fand: 20^h 52′ . . . . 158° 51′.

Für die Richtung des Schweifs fand sich: 0° 38′."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 3, 4.)

"Der Comet wurde mit blossem Auge aufgesucht und erkannt um 18^h 33^m, wo

die Sonne also nur 6 bis 7 Grad unter dem Horizonte stand. Das Aussehn des Fächers am Kern hat sich seit der letzten Beobachtung erheblich verändert, indem er sich besonders nach der nachfolgenden Seite hin in eine scharfe Spitze verlängert hat. Im Innern des Fächers wurde nur eine hellere Ausstrahlung bemerkt. Ausserdem zeigt sich heute in grösserer Entfernung vom Kern ein heller fast linienartiger Bogen, dessen Scheitel genau nach Süden liegt, der Glanz dieses scharf begränzten Bogens übertrifft erheblich den der angrenzenden Nebelmasse; an seinen Enden geht er aber allmälig in dem Schweif über, so dass letzterer gewissermassen die Fortsetzung desselben zu bilden scheint.

Messungen und Schätzungen.

1. Am Kern und Fächer.

$18^h\ 55^m$. Durchmesser des Kerns 2″.

Vorangehende Spitze des Fächers, Richtung 247°, Abstand 8″.

Hellste Richtung 200°, dabei eine Ausdehnung von 12″.

Anfangsrichtung der Fächergränze auf der nachfolgenden Seite 91°, dabei Ausdehnung 12″.

Nachfolgende Spitze: Richtung 49°, Abstand 16″.

2. Am Halbbogen.

$19^h\ 34^m$. In der Richtung nach Süden und gleichfalls auf beiden Seiten im Parallel des Kerns: Abstand 25″.

Ende des Bogens auf der vorangehenden Seite: Richtung 300°, Abstand 40″.

Ende des Bogens auf der nachfolgenden Seite: Richtung 70°, Abstand 45″.

3. Am Schweif.

Richtung der Tangente:

Auf dem Parallel des Kerns,	vorangehend 330°.
" " "	nachfolgend 39°.
In 2′ Abstand vom Kern,	vorangehend 340°.
" " "	nachfolgend 29°.
In 6′ Abstand vom Kern,	vorangehend 348°.
" " "	nachfolgend 14°.

Breite des Schweifs bei 2′ Abstand, ungefähr 2′.5.
" " 6′ " " 5′.

Die Theilung des Schweifs fängt erst an bei 2 bis 3 Minuten Abstand vom Kern.

4. An der südlichen Nebelhülle.
Hauptrichtung unter 169°, dabei Ausdehnung 3′.
Ausdehnung auf dem Parallel des Kerns, vorangehend 1′.5.
" " " " " nachfolgend 2′.5.

"Anmerkung. Ueber die äussere Begränzung des Cometen in der Nachbarschaft des Kerns, wurden um 19^h 15^m einige Schätzungen angestellt. Später ergab sich dass damals noch die Dämmerung zu stark gewesen war, so dass ich theilweise den hellen Halbbogen für die Begränzung angesehen hatte. Am folgenden Tage ergänzte ich aus der Erinnerung: Abstand der äusseren Gränze des Cometen im Parallel des Kerns auf der vorangehenden Seite 35″, auf der nachfolgenden 50″, und diese Angaben, für deren Genauigkeit ich nicht einstehen kann, sind in der Zeichnung II. benutzt worden." (Plate XLIX. 20.)

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 22.)

"18^h 31^m Sternz. Der Comet zeigt beim Einstellen sich in der Gestalt *abck* (Plate XLIX. 21). Keine Spur der Schweifumhüllung, Vergrösserung 169f. Als es dunkler wurde kam allmälig die früher gesehene Figur der Umhüllung des Kerns ebenfalls zum Vorschein: die ausgeführte Skizze gilt für 19^h 14^m Sternzeit. Gemessen wurde: Richtung $k\,a = 175°.5$. 5 Beob. Richtung $b\,c = 282°.4$. 5 Beob. Länge $k\,a = 16''$, $k\,b = 9''$, $k\,c = 15''$, $k\,m = 34''$; nach Schätzungen durch Vergleichung mit den dicken Fäden auf die früher angegebene Weise.

"Die Linie *b c* ist im Originale definirt; als die Linie vom äussersten Punkte links unten am Sector nach dem symmetrisch gelegenen Punkte der rechten Seite. Länge $o\,n = 1'.3$.

"Von der schwachen Umhüllung konnte ich heute Nichts erkennen. Heller Mondschein."

(Ibid., p. 20.)

"19^h 28^m Sternz. D = 1″.98. 2 Beob. Der Comet war bei der unreinen Luft schwach und äusserst unruhig."

(Ibid., p. 30.)

"23^h 15^m Sternz. $p = 4°.55$. 6 Beob."

1858. September 25. (Plates XXXI. and XLIX. 23, 24, 25.)

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"A grand object. In twilight too strong for the tail to be seen, the outline of the envelope *B*, as bounded by the dark arc, is of the form of a half-moon with the nucleus in the edge."

By the diagram the nucleus is placed on the margin away from the sun, ex-

[illegible] 4. [illegible]

[illegible] Ausdehnung II. [illegible]

Ausdehnung [illegible] des Kerns, vorangehend 1'.5.

" " nachfolgend 2'.5.

[illegible] Begränzung des Cometen in der Nachbarschaft [illegible] einige Schätzungen angestellt. Später ergab sich [illegible] Dämmerung zu stark gewesen war, so dass ich theilweise [illegible] für die Begränzung angesehen hatte. Am folgenden Tage [illegible] aus der Erinnerung: Abstand der äusseren Gränze des Cometen im [illegible] des Kerns auf der vorangehenden Seite [illegible], auf der nachfolgenden 50", [illegible] Angaben, für deren Genauigkeit ich [illegible], sind in der Zeichnung II. benutzt worden." (Plate XLIX. [illegible])

POULKOVA. WINNECKE (*Pub. Russ.* [illegible])

"13ʰ 31ᵐ Sidereal. Der Comet [illegible] *abck* (Plate XLIX. 21.) [illegible] [illegible] [illegible] gemessen wurde; Richtung [illegible] Länge ka = 16" [illegible] durch Vergleichung mit den [illegible]

"Die Linie bc ist [illegible] Punkte links unten am [illegible] Punkte der rechten Seite. Länge cn [illegible]

"Von der schw[illegible] Heller Mondschein."

[illegible]

"[illegible] Luft schwach [illegible]

[illegible]

"23ʰ [illegible]

1858. September [illegible]

[illegible]

"A grand object. [illegible] the tail to be seen, the outline of the envelope *B* [illegible] the form of a half-moon with the nucleus on the edge.

By the diagram the nucleus is placed on the margin away from the sun, ex-

COMET OF DONATI 1858.

SEPTEMBER 25TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE. PLATE XXXI

G.P. Bond Del. J. W. Watts Sc.

COMET OF DONATI 1858.

SEPTEMBER 27TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE. PLATE XXXII

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centrically towards the preceding edge. This margin is curved like the boundary between the bright and the dark part of the moon when five or six days old, and is not wanting in decision of outline.

"The amplitude of the arc is 240°. Four envelopes are in sight, including as one of them the exterior haze. The nucleus has all the *intensity* of a star of the 7th magnitude. In front of it the diffused light can scarcely be traced more than 3′ towards the sun. The tail is 5′ to 6′ broad at 12′ from the nucleus."

The following gradations of light were observed:

1.) The dark axis of the tail reaching quite up to the nucleus.
2.) A bright wisp attached to the nucleus (the envelope C).
3.) A dark arc just outside of C, not very decided.
4.) A very bright crescent (the outer margin of the envelope B) bounded by
5.) A dark arc.
6.) The outer part of envelope A, beyond which is
7.) A dark arc.
8.) Exterior haze, with the background of the sky beyond it.

A figure drawn to illustrate the appearance of the nucleus and nebulosity adhering to it, shows the breadth of the dark stripe in the axis of the tail to be only 2″.5, just in the rear of the nucleus. In Plate XXXI. it is perhaps a little too broad.

The diameter of the nucleus, by measurement from a diagram, was $< 4''$?

The following measurements were made:

Nucleus to middle of dark space in front of C	$=$ 8″.9.
" " $b' =$ vertex of B . . .	$=$ 18 .0.
Transverse diameter of $B = bb''$ . . .	$=$ 39 .4.

The breadth of the dark arc outside of B is about 4″.

CAMBRIDGE, ENG. BREEN. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 17.)

"'Nucleus large and bright; no dark space between it and the arch.' A sketch exhibited in other respects the same appearances as on Sept. 24."

ANN ARBOR. BRÜNNOW. (*Mss.*)

"The first night on which I made a drawing was the evening of the 25th. (Plate XLIX. 24.) Then, as on the 26th, the Comet resembled one of the drawings of Halley's Comet made by Bessel. A broad, fan-shaped jet of light was emitted from the nucleus towards the sun, the ends of which, bending backwards, formed the inner part of the tail. This was surrounded by a bright parabolic envelope, but separated from it by an entirely dark space."

PARIS. CHACORNAC. (*Bulletin Obs. Imp. de Paris.*)

"Le 25 7^{bre} à $4\frac{1}{2}^{h}$ du matin, l'enveloppe qui se trouvait le 23 très-rapprochée du noyau, s'en est écartée d'une quantité assez considérable; autour de celui-ci une cinquième enveloppe se degageant comme l'avait fait la quatrième. Des mesures des demi-diamètres de ces enveloppes sont prises dans divers angles de position.

"À 5 heures les images des arcs lumineux et celles du noyau apparaissent colorées lorsqu'on applique à la grande lunette un polariscope Arago.

"À 6^h 4^m l'image du noyau de la Comète n'est plus visible dans la lunette armée d'un faible grossissement.

"Du 25 7^{bre} au 8 8^{bre} deux autres enveloppes se sont encore dégagées du noyau. La sixième brillait d'un éclat vif, et présentait de la lumière nettement polarisée."

BERLIN. FÖRSTER. (*Astron. Nachrichten,* 1205, p. 68.)

"Der Kern seit dem 21^{sten} Sept. entschieden kleiner geworden. Die Ausströmung jetzt in der deutlichen Form eines fächerförmigen Kammes oder Sectors."

(Ibid., p. 69.)

"Durchmesser des Kerns reducirt auf die Entfernung 1 = 3″.4."

DORPAT. MÄDLER. (*Beob. der Kaiserl. Sternw. Dorpat,* XV. p. 39.)

"Messungen des Kopfs: 18^h 31′ . . . . . 2″.876.
Die Ausstrahlung zeigte sich heut deutlich als gut begrenzter Kreisausschnitt von etwa 200 Graden des Umfangs. Sie war seit 18^h 32′ sichtbar.

Richtung der Ausstrahlung 18^h 36′ . . . . . 167° 49′.3.
19 3 . . . . . 167 10.

Richtung des Schweifes (seit 18^h 45′ sichtbar) 19^h 8′ . . . . . 4° 2′.

Der Halbmesser des Ausstrahlungskreises, von der Mitte des Kopfs aus bis zum Apex gemessen fand sich um 18^h 48′ . . . . . 17″.275. Der gegenüberliegende (160° umfassende) Ausschnitt war dunkler, selbst mit dem heut ziemlich schwach glänzenden Schweife verglichen. Die südlichste Partie des Schweifes ging noch etwas über die Ausstrahlung hinaus.

"Eine kreisförmige Begrenzung der Ausstrahlung schien auch schon gestern Statt zu finden, doch war der Luftzustand nicht günstig genug um darüber Gewissheit zu erlangen."

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten,* 1169, p. 261.)

"Komet sehr lichthell; Durchm. bei 30 Bog. Secunden; in dem den Kern des Kometen umhüllenden Nebel bemerkt man eine Parabel von verdichteter Nebelmasse, welche den Kopf auf der Vorderseite umfassend mit ihren beiden Aesten

nach rückwärts in dem Schweife sich fortsetzt und allmälig mit der Schweifmaterie zusammenfliesst."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 22, 23.)

"18^h 54^m Sternz. Wesentlich hat sich das Aussehen des Cometen nicht geändert, $k\,a = 17''$, $k\,b = 8''$, $k\,c = 16''$. Bedeutung der Buchstaben wie gestern. Starker Sturm und nicht ganz reiner Himmel.

"20^h 45^m. $k\,a = 21''.0$. 2 Einstellungen am Heliometer.

"Es ist jetzt sehr klar und man sieht trotz des tiefen Standes die schwache Hülle; sie ist aufgebläht in der Richtung 140°, 1 Mess. und scheint concentrisch mit dem kleinen Sector. Es wird dieser Positionswinkel und die Bemerkung durch die um 18^h 45^m gemachte Skizze vom Sector bestätigt, bei der die Richtung des Parallels angegeben ist; daraus wurde $p = 145°$ folgen.

"Abstand der schwachen Umhüllung vom Kerne in dieser Richtung 3′, im Parallel des Kernes, vorgehend 2′, nachfolgend 3′."

(Ibid., p. 30.)

"20^h 30^m Sternz. $p = 4°.47$. 6 Beob.

"Der Schweif ist in der Mitte viel dunkler als an den Seiten; diese verlaufen allmälig in den Himmelsgrund."

1858. September 26. (Plate XLIX. 26, 27, 28.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 214.)

"Sept. 26. Formedelst mœrke, uafladelig forbidragende Skyer lykkedes i Aften ingen tilfredsstillende Stedsbestemmelse; i lyse Intervaller gjordes kun nogle faa Bemærkninger om de siden forrige Observationsaften indtraadte physiske Forandringer.

"Det bemærkedes strax, at den lyse Sektor ved Kjærnen imidlertid havde faaet en betydelig Udvidelse, saaledes at, medens paa hœire Side den forrige Radius (Sept. 23) næstendeels var forbleven i sin tidligere Stilling, den venstre Grændse nu derimod stod aldeles lodret paa Axen. Lysmateriens Udlœb paa hœire Side (i Kikkerten) var forresten endnu meget tydelig og kraftig tilstede i Aften, saaledes som jeg har forsœgt at udtrykke det Fig. V. (Plate XLIX. 27, 28.) I Glands og Lysstyrke naaede Kometen nu vel til Arktur, med hvilken Stjerne den i denne Henseende godt kunde sammenlignes, da de begge to stod omtrent i samme Hœide."

DORPAT. MÄDLER. (*Beob. Kaiserl. Sternw. Dorpat*, XV. p. 40.)

"Die Begrenzung der kreisförmigen Ausstrahlung wie gestern. Für die Richtung der Ausstrahlung:

der Ausstrahlung:	18^h 45′ . .	174° 43′.5.
	18 56 . .	174 56.

Richtung der Ausstrahlung: 20^h 38′ . . . 175° 42′.3.
Für die Richtung des Schweifes 19 13 . . 5 30.7.
Halbmesser des Segments der Ausstrahlung: 19^h 2′ . . 19″ 918."

GENEVA. PLANTAMOUR. (*Note sur la Comète de Donati*, p. 7.)

"C'est le 26 septembre, au soir, que j'ai remarqué pour la première fois le secteur lumineux partant du noyau dans la direction du soleil; . . . . .

"L'ouverture du secteur lumineux était d'environ 130°."

The noticeable features on the 27th are, the smallness of the nucleus succeeding the detachment of the latest envelope, the bright border of the envelope *B*, and the general depression of the envelopes, as on previous dates, to the right of the axis of the tail, causing them to set awry upon it.

1858. September 27. (Plates XXXII. and XLIX. 29, 30.)

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

The outline of the new envelope, *C*, was clearly distinguished. "It sets awry, inclining to the right of the axis. The outline of *A* is becoming very indistinct. The narrow dark stripe in the axis of the tail, having its vertex precisely at the nucleus, is a remarkable object. Its vertex may perhaps incline a little to the following side of the nucleus." On the 29th a ray was seen projected from the following side of the nucleus, which, it was thought, may have given this appearance on the 27th.

The following measurements were made:—

Nucleus to vertex, *b′*, of the brightest envelope, *B*, ...	= 23″.1
" " middle of dark interval between *B* and *C*, ...	= 10 .7
Transverse diameter of *B* on a line through the nucleus inclined by 19° to the axis of the tail, ...	= 59 .1
Breadth of the bright rim or border of the envelope *B*, ...	= 5 .8
Transverse diameter of *C* (probably measured at the same inclination as for *B*), ...	= 20 .5
Breadth of dark stripe at 30″ from the nucleus, ...	= 4 .9

CAMBRIDGE, ENG. BREEN. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 17.)

"The luminous sector very bright and beautifully seen; the nucleus is now extremely small, and bright like a star,—almost dissipated, except a brilliant point,—quite changed since Sept. 25th. . . . . .

"According to a sketch, the nucleus was round, and attached to it on the upper side (as seen in the telescope) was a luminous sector, depressed towards the tail on the right side. The coma extended beyond to a distance greater than the

radius of the sector, and was terminated by a bright border, between which and the sector was a darker space."

CAMBRIDGE, ENG. CHALLIS. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 18.)

"A drawing which I took at this time (Plate XLIX. 30) exhibited a small, fan-shaped centre, the broader part turned from the tail, and the brightness increasing towards the narrow part, which had a small, circular, and very bright termination (which is properly the nucleus). This central part was surrounded, except for about 90° on the side towards the tail, with a kind of hood or envelope, less bright and much larger than the central part, but bright enough to be in definite contrast with the coma, which extended from it to a breadth about equal to its radius. The hood was more depressed towards the tail on the right side (as seen in the telescope) than on the left side. The right side of the tail was also considerably the brighter; the intermediate part was comparatively dark. A star of mag. 8, seen through this part, at the distance of a few minutes from the nucleus, exhibited no unusual phenomena. By measurement with a position-circle, the axis of the tail was inclined southward from the great circle through the pole by 8°."

DORPAT. MÄDLER. (*Beob. Kaiserl. Sternw. Dorpat*, XV. p. 41.)

"Starke Bewölkung, die nur abwechselnd durch helle Lücken den Cometen zu beobachten gestattet. Die Ausstrahlung von derselben Form wie am 25 und 26. Nach 19^h 40′ vollständige Trübung.

Halbmesser der Ausstrahlung: 18^h 52′ . . 21″.510.
Richtung 18^h 57′ . 170° 31′.3."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 4.)

"20^h 35^m. Der südliche Auswuchs des Cometen war heute im Sucher leicht zu erkennen. Seine grösste Längenausdehnung betrug ungefähr 5′, in der Richtung 172°, welche auch nahezu mit der Richtung der hellsten Ausstrahlung im Fächer zusammenfiel. Der Halbbogen war mehrere Secunden breit und durchaus symmetrisch um den Kern belegen."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 23.)

"Es wurde erst ordentlich heiter, als der Comet schon sehr tief stand; die Unruhe der Luft erlaubte keine Detailbeobachtungen über die Ausstrahlungen, die übrigens wesentlich sich nicht geändert zu haben scheinen. So die Notiz jener Nacht. Zwei gleichzeitig entworfene Skizzen zeigen aber übereinstimmend beträchtliche Aenderungen gegen früher; denn nach ihnen waren Erscheinungen die am 29 Sept. beschrieben sind, schon damals vorhanden; ich meine die Andeutung eines grössen Sectors, oder besser einer ringförmigen Verdichtung in der Schweifmaterie vor dem Sector. Da aber bei der schlechten Luft keine erträgliche

Bestimmung der Dimensionen möglich gewesen ist, so gebe ich diese Skizzen nicht.

"Abstand der schwachen Hülle vom Kern in der Richtung der Aufblähung 2′.7 – 3′. Im Parallel des Kernes vorgehend 1′.3, folgend 2′.5. Breite des hellen Stromes in dieser Richtung 1′.7."

(Ibid., p. 30.)

"22^h 15^m Sternz. $p = 8°.66$. 8 Beob.

"Die dunkle schmale Zone in der Mitte des Schweifes, in fast dem Himmelsgrunde gleichem Lichte, ist heute sehr auffallend."

1858. September 28. (Plate XLIX. 31, 32, 33.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs,* 1858, p. 215.)

"Der er siden den forrige Observationsaften en særdeles betydelig Forandring foregaaet i Kometens Hoved. Den venstre Radius har nemlig atter dreiet sig *opad,* og det er ved første Øiekast allerede iøinefaldende, at Kjærnen i Aften ligger betydelig *excentrisk* i Lyssektoren, saaledes som den medgivne Tegning (Fig. VI. Plate XLIX. 32) viser det. Efter en kort Meddelelse i *Monthly Notices,* XIX. p. 145, har Hr. *Rosa* i *Rom* allerede tidligere, den 11 Septbr., iagttaget en lignende excentrisk Stilling. Men desforuden har der nu et nyt Hylster indfundet sig, der, om end langt svagere end Kometens egentlige, sædvanlige Hale, alligevel tydeligt nok indhyller Kjærnen og Hovedet."

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

An attempt was made to photograph the image of the Comet in the focus of the great refractor, but only the nucleus and a little nebulosity 15″ in diameter acted on the plate in an exposure of six minutes. In the Comet-seeker, "the dark opening in the axis of the tail occupies about one twelfth of its breadth at a distance of 1° from the nucleus; it may be traced distinctly for one or two degrees. The head of the Comet, seen with the finder in strong twilight, which obliterates all but this brightest portion, is crescent-shaped."

MARKREE. GRAHAM. (*Obs. of Donati's Comet,* 1858, *Markree,* p. 8.)

"Viewed with the large achromatic, the first impression was the stellar character of the nucleus; the light was more concentrated than heretofore, and still rather stronger and more sharply defined on the N. side; on that side, too, it seemed slightly lopped off, so as to be straight for a small distance, at an angle, as before, of 105° with the axis of the tail. The next impression was a startling confirmation of my conjectures, as to a crescent shape; the envelope immediately surrounding the nucleus was almost a perfect semicircle, the eastern cusp being

a little more elongated than the western. The thickness of this envelope was about twice the diameter of the nucleus.

"We have seldom seen Venus, in this climate, more sharply defined than was this crescent-shaped (nearly semicircular) envelope, as well on the convex as on the concave side; it was particularly so at the former (the S.), for on the latter side the continuation was interrupted by the nucleus, which stretched a little way N. of the boundary line. A fainter envelope circumscribed the former one, of apparently the same texture and material as the tail; its thickness, about half that of the former; once or twice I fancied that in this, too, I saw traces of a phase, but no other eye confirmed this suspicion, and it was only one or two glances I got of it. The E. side of the tail was, as before, decidedly brighter and broader than the other, — in fact, it occupied nearly half the breadth of the tail; the W. side, a quarter; and the other quarter was little else than the pure azure of the sky."

NEUCHATEL. JEANJAQUET. (*Souvenirs de la Comète de* 1858, p. 8.)

"Aujourd'hui 28 septembre, il me paraît intéressant de noter la première visibilité de l'astre, qui, vu le temps propice, ne peut manquer de se montrer de très-bonne heure; il est 6 heures 17 minutes. Je signale en même temps Arcturus et Véga. Mais rappelons-nous que ces étoiles ne sont pas à l'horizon, et que tandis que l'obscurité s'est déjà faite en quelque sorte pour elles, elle est loin de s'être encore faite pour le météore."

MUNICH. LAMONT. (*Jahresbericht der k. Sternw. München*, p. 17.)

"Am 28 September sah ich eine parabolische Begrenzung um den Kopf, und eine fächerförmige Ausströmung des Lichtes vom Kerne aus in der Richtung der Sonne."

DORPAT. MÄDLER. (*Beob. der Kaiserl. Sternw. Dorpat*, XV. p. 41.)

"Nur 8 Minuten lang machte das dichte Regengewölk dem Cometen Platz. Die Ausstrahlung kreisförmig, aber nach der Seite des Schweifs zu zeigen sich wieder die concaven Gebilde wie am 19. Für die Richtung: $20^h\ 52'$ . . $166°\ 54'$. Ein Mehreres konnte heute nicht erhalten werden."

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, pp. 312, 313.)

"Erst am Abend des 28^{sten} heiterte es sich völlig auf und um $6^h\ 15^m$ m. Z. sah ich den Cometen bei 42 ff. Vergr. des $3\frac{1}{2}$ ff. Aequatoreals. Sein Aussehen hatte sich seit Sept. 22 erheblich geändert, jedoch fand ich wie damals die rechte, vorangehende Seite der Coma und des Schweifes heller als die linke. Der Kern, beiläufig von $2''$ bis $3''$ Durchmesser, war auf der Sonnenseite, anstatt von der früheren verwaschenen Ausströmung, von einem beinahe scharf begrenzten Sector von etwa $170°$ Umfang umgeben, über dem eine etwas schwächere parabolische

gekrümmte Zone lag, die mit ihren beiden Aesten den Schweif bildete. 6^h 30^m sah ich den Cometen bei stärkeren Vergrösserungen im 4 ff. Fraunhofer. Die Helligkeit der Erscheinung war auffallend. Ich habe nicht sehr sorgfältig darauf geachtet ob der Sector gegen die über ihm liegende Zone ganz scharf abgeschnitten war; meine Zeichnungen deuten darauf hin, dass ein nahezu allmäliger Uebergang stattfand, so dass die Helligkeit des äusseren Sectors unmittelbar an der Begrenzung des innern am grössten war. Einen deutlichen Umriss des innern Sectors habe ich mit Sicherheit wahrgenommen; die Figur schien mir sehr nahe die eines Kreisausschnitts zu sein, mit einem Radius von etwa 15″. Bei eingetretener Dunkelheit zeigte sich über der parabolischen Zone dem äussern Sector, eine zweite schwächere Umhüllung, deren äusserste Grenzen ich bis etwa $2\frac{1}{2}'$ vom Kern verfolgen konnte, und deren Helligkeit von innen nach aussen allmälig abnahm. Gegen diese äussere Umhüllung war die den innern Sector umgebende parabolische Zone, deren Scheitelradius ich zu 35″ schätzte, ziemlich scharf begrenzt. Ich muss noch erwähnen, dass die linke Seite des innern Sectors erheblich heller war als die rechte, die in einer Ausdehnung von etwa 30° sich ganz verwaschen zeigte, etwa so als ob hier ein erhebliches Ueberströmen der Lichtmaterie aus dem Sector in den vorangehenden Schweifast stattfände.

"Nach unten war der Kern und der Ausströmungs-Sector scharf begrenzt durch eine dunkle Zone von gleichfalls parabolischer Form, deren Grenzen die innern scharf hervortretenden Umrisse der beiden Schweifäste bildeten. Die Axe dieser parabolischen Zone, allem Anschein nach gleichzeitig die Axe des Schweifes, war noch bezeichnet durch einen innern dunkleren Canal. Diese dunkle Zone war sowohl im Cometensucher, wie mit freiem Auge weit in den Schweif hinauf zu verfolgen, den sie offenbar der ganzen Länge nach in zwei ungleiche Aeste theilte.

"Die Mittellinie der Ausströmung schien mir nahe mit der verlängerten Schweifaxe zusammen zu fallen; Herr Prof. *Peters* schätzte ihre Richtung 10° nach links von dieser Linie."

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 261.)

"Der Kern des Kometen wird kleiner, aber viel intensiver und brillanter; zunächst umgiebt ihn eine dichtere parabolischgeformte Masse, über dieser befindet sich in dem Kopfnebel in einem kleinen Abstande die am 25 Sept. bemerkte Lichtparabel."

1858. September 29. (Plates XXXIII. and XLIX. 34, 35, 36.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 215.)

"Den 29 Septbr., var Luften om Aftenen meget disig, men man saae alligevel nok for at forvisse sig om, at det forhen omtalte nye Hylster af 28 Septbr. nu

havde udviklet sig saaledes, at det var bleven til en *anden Hale.* Halernes Axer dannede med hinanden, efter mit og Hr. Thiele's uafhængige Skjøn, en Vinkel paa omtrent 140 Grader. Dette uventede og, saavidt mig vitterligt, sjeldne Syn minder stærkt om en Tegning af den Halleyske Komet ved Sir John Herschel i Capreisen.* Den her omtalte og paa mine Tegninger (Plate XLIX. 36) anskueliggjorte Forlængelse af det taageagtige Hylster er, mærkelig nok, *slet ikke identisk* med en anden, netop paa den Tid af andre Iagttagere observerede Sidehale. Denne sidste dannede nemlig en langstrakt, svag, retlinet Lysstribe *ved Siden* af Hovedhalen, saaledes at den paa en Maade tangerede Hovedhalen, ved dens Udspring.† Jeg har i disse, rigtignok aldrig ret klare Aftener ikke seet Noget til Sidehalen, men om den ovenfor beskrevne, efter al Rimelighed ikkun meget kortvarige Hale, som altsaa har været den tredie, kan der aldeles ikke være nogen Tvivl."

Observatory of Harvard College. G. P. Bond.

"Marked changes have occurred since the 27th. The little half-moon envelope, then closely shrouding the nucleus, has elevated itself above it and become the most conspicuous feature in the telescopic view. It is a very little brighter near its outer edge. It is in a disturbed, clouded, curdled, or chaotic state, not evenly diffused as the outer envelopes are. Besides the outline of the dark axis of the tail, perhaps 20″ broad at 4′ from the nucleus, there is evidently a ray proceeding from the latter on the following side."

Dorpat. Mädler. (*Beob. der Kaiserl. Sternw. Dorpat*, XV. pp. 41, 42.)

"Die Ausstrahlung zeigte sich heut ganz verändert. Sie war merklich grösser und bestand aus 3 concentrischen Zonen. Die innere zunächst dem Kopfe am hellsten, aber unvollkommen begrenzt, etwa $\frac{1}{3}$ der Ausdehnung des Ganzen. Die zweite Zone dunkel, und nur wenig heller als der Schweif, die dritte an Helligkeit zwischen den beiden innern das Mittel haltend. So zeigte es sich gegen 19^h; aber später (etwa 20^h $20'$) hatte das Ganze, wie die einzelnen Zonen an Ausdehnung zugenommen; die innere zeigte sich besser begrenzt, aber dem Anschein nach etwas weniger hell als vorher.

Messungen.

Halbm. des Ganzen	$18^h\ 57^m$ . . .	28″.127.
Halbm. der innern Zone	$20^h\ 19^m$ . .	16″.645.
Halbm. des Ganzen	$20^h\ 24^m$ . . .	34″.623.

* *Results of Astronomical Observations*, London, 1847, Plate XV. Fig. 3.

† Jvfr. Tegningen hos *Bond*, *Account of Donati's Comet*, p. 15, Fig. 9, og blandt Andet hvad Prof. *Listing* i Gœttingen desangaaende meddeler i *Astron. Nachr.*, Bd. XLIX. p. 231.

"Richtung der Ausstrahlung 18^h 48^m . . Mittel 166° 48′.
" " " . 20^h 13^m . . Mittel 168° 33′.3.
. . . .
"Richtung des Schweifes 20^h 30^m . . Mittel 11° 40′."

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, p. 313.)

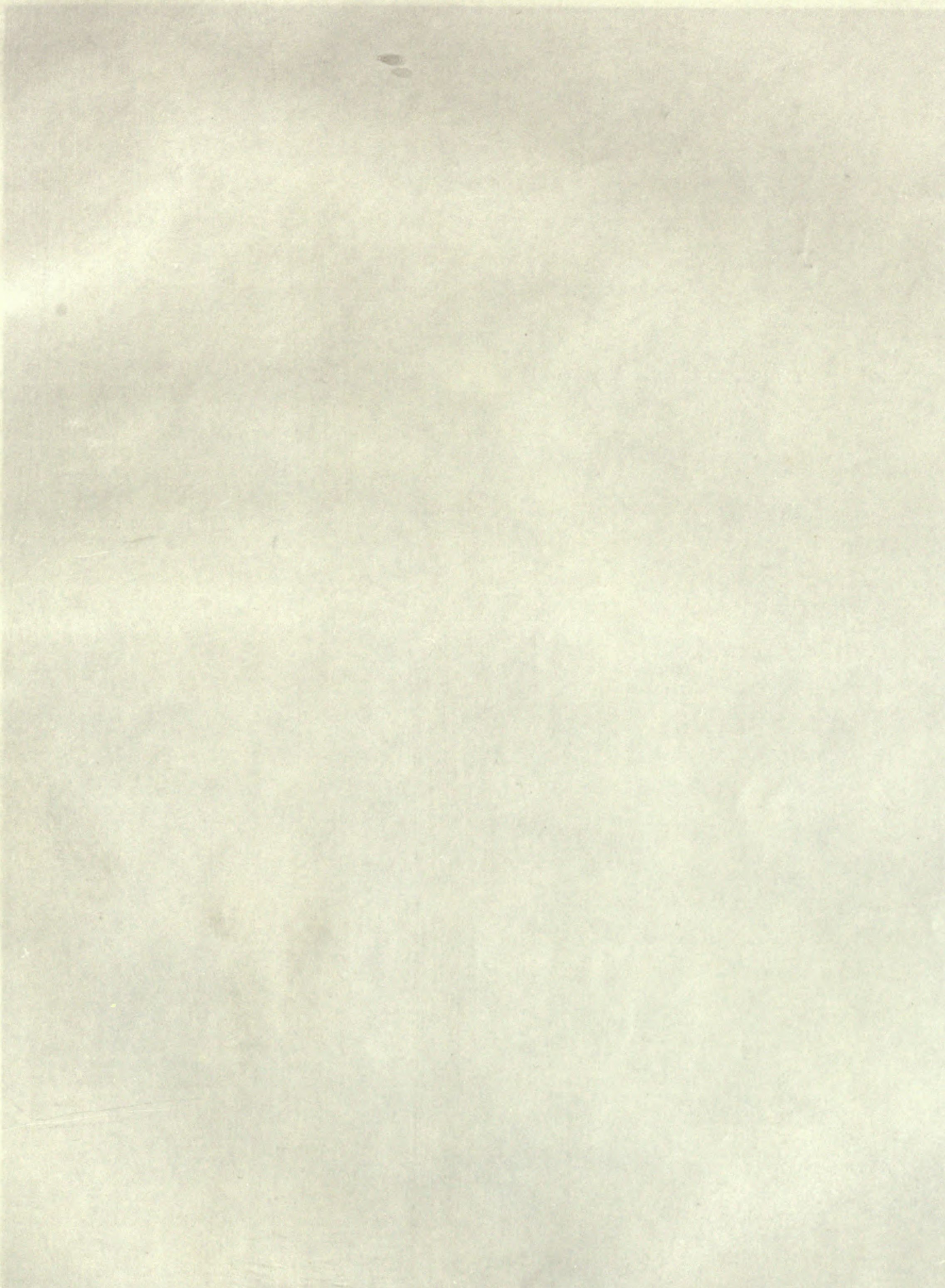
"Septbr. 29 war der Comet kurze Zeit zwischen Wolken sichtbar; jedoch war seine Erscheinung hinreichend deutlich, um zu zeigen, dass die Richtung der Ausströmung seit gestern sich von der Richtung der Schweifaxe nach rechts entfernt hatte. Ich schätzte den Winkel zwischen beiden Richtungen zu etwa 30°, muss aber dabei bemerken, dass die Schätzung der Mittellinie des ausströmenden Sector gestern, heute, und an den folgenden Abenden erheblich unsicher war, eine Folge der grossen Ausdehnung in der die Erscheinung sich zeigte."

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, pp. 261, 262.)

"Kern des Kometen von 15 Bog. Secunden Durchmesser; die dem Kerne gestern anliegende parabolische Masse entfernt sich von diesem; die Lichtparabel vom 25 Sept. wird schwächer, zerfliesst in den allgemeinen Nebel. Der Kern ist auf der Hinterseite gut begrenzt; auf dem Vorderrande mehr verwaschen. Hinter dem Kerne gewahrt man im Schweife einen dunklen Streifen, der entsteht, indem die den Schweif bildende Materie auf der Vorderseite des Kernes ausströmt, und dann nach rückwärts in zwei parabolischen Aesten abfliesst, die sich erst in einiger Entfernung hinter dem Kerne vereinigen und so einen Streifen übrig lassen, durch welchen man den dunklen Himmelsgrund sieht."

COLLEGIO ROMANO. SECCHI. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 13.)

"Il 29 settembre era progredito ancora l' allargamento angolare del ventaglio, il quale si era aperto fino ad arrivare a 270°, e il nucleo restava nell' angolo oscuro rientrante tra due raggi estremi. Esso era ovale e decisamente rotondo dalla parte della coda, ma dalla parte del ventaglio rassomigliava la fase di Venere leggiermente convesso. L' intensità della sua luce andava scemando dalla parte convessa verso il ventaglio de' raggi, coi quali si confondeva insensibilmente. La maggior dimensione del nucleo (cioè la trasversale alla coda) era 9″.41, e la minore (quella cioè nella direzione della coda) 8″.5. La distanza della parte convessa (posteriore verso la coda) del nucleo alla sommità del ventaglio era 24″.0; la direzione o angolo di posizione dell' asse maggiore del nucleo era 83°.47. La larghezza del ventaglio sulla linea diametrale del nucleo = 43″.75, larghezza del medesimo alla estremità de' due ultimi raggi = 51″.45. I due raggi però non erano ugualmente lunghi e la linea media del loro angolo non coincideva col mezzo della coda. L' inviluppo esterno del paraboloide nebuloso fu trovato 4′.6; l' angolo di posizione della coda = 11°.22.



"Richtung der [illegible] 18h 48m Mittel 166° [illegible]

[illegible] 20h 15m Mittel 168° 33'[illegible]

"Richtung [illegible] 20h [illegible] Mittel 11° 40'."

[illegible]

[illegible] zwischen Wolken [illegible], jedoch war [illegible] Aus- [illegible] Sector [illegible] Folge [illegible]

[illegible]

"[illegible] dem Kerne [illegible] parabel [illegible] Sept. wird [illegible] Kern ist [illegible] Hinterseite gut [illegible]. Hinter dem Kerne gewahrt man [illegible], der entsteht, indem die den Schweif bildende [illegible] des Kernes ausströmt, und dann nach rückwärts in [illegible] abfliesst, die sich erst in einiger Entfernung hinter dem Kerne [illegible] und so einen Streifen übrig lassen, durch welchen man den [illegible] sieht."

COLLEGIO ROMANO. [illegible] Coll. Romano, 1859, p. 13.)

"Il 29 settembre [illegible] l' allargamento angolare del ventaglio, [illegible] si era aperto [illegible] 27°0', e il nucleo restava nell' angolo [illegible] era [illegible] e decisamente rotondo [illegible] della [illegible] ventaglio rassomigliava la fase di Venere [illegible] fase andava scemando dalla parte [illegible] si confondeva insensibilmente. La [illegible] del nucleo (cioè [illegible] coda) era 9".41, e la minore [illegible] della [illegible] La distanza della parte convessa [illegible] del ventaglio era 24".0; la distanza [illegible] del nucleo era 83".47. La larghezza del ventaglio [illegible] nucleo = 43".75, larghezza del [illegible] I due raggi però non erano [illegible] angolo non coincideva col mezzo della coda. [illegible] del paraboloide nebuloso fu trovato 4'[illegible]; l' angolo di posizione della coda = 11°22'.

G. P. Bond Del. J. W. Watts Sc.

COMET OF DONATI 1858.

SEPTEMBER 29TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE.

Printed by Chas. D. Andrews.

"Intorno a queste misure è da osservare che la cattiva terminazione degli oggetti le rende non poco incerte; di più il nucleo non sopportava che l' ingrandimento di circa 200 volte, dopo di che diventava enormemente confuso e sfumato. A questa circostanza si deve la notabile diversità trovato da vari astronomi tra le misure del nucleo stesso. Così il Signor Donati e il Signor Maedler lo fanno di 3″ soli; diversità che io non saprei spiegare altrimenti, e che eccede tutti i limiti probabili degli errori nella misura di questo oggetto, mentre del resto assai bene combinano le misure degli inviluppi esterni. v. Astron. Nachricht. no. 1167, pag. 227. Del resto, le forme de' vari ventagli, aloni o inviluppi descritti dal Signor Donati ben combinano colle nostre."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 5.)

"$18^h\ 55^m - 20^h\ 0^m$. Im Innern des ersten Fächers hat sich jetzt ein zweiter gebildet, der in seiner Achse mit der das letzte Mal bemerkten helleren Ausstrahlung im Fächer nahezu zusammenfällt. Der symmetrisch um den Fächer belegene Halbbogen hat an Breite erheblich zugenommen und zwar nach innen zu, so dass er sich dem Fächer genähert hat, und das ihn von demselben trennende, dunklere Intervall viel kleiner geworden ist, als wie es zwei Tage früher war. Wolken und Wind stören die Messungen.

Messungen und Schätzungen.

1. Am Fächer.

Vorangehende Spitze, Richtung 315°, Abstand 7″.
Nachfolgende " " 86°, " 15″.
Abstand auf dem Parallel des Kerns, vorangehend 12″.
" " " " " nachfolgend 14″.
" in der Richtung nach Süden 14″.
Vorangehende Spitze des innern Fächers 244°.
Nachfolgende " " " 165°.

2. Am Halbbogen.

Aeussere Begränzung, Abstand in der Mitte $2^r.80 = 27''.3$.
" " " auf dem Parallel des Kerns, vorangehend $3^r.13 = 30''.5$.
Aeussere Begränzung, Abstand auf dem Parallel des Kerns, nachfolgend $3^r.40 = 33''.1$.
Vorangehendes Ende, Richtung 313°.
Nachfolgendes " " 62°.
Richtung der Tangente in der Mitte 97°.

"Die Breite des Halbbogens ist gleich der Breite des dunkleren Intervalls, das ihn vom Fächer trennt. Sein Glanz ist in der Mitte am stärksten.

"Der die beiden Schweifhälften trennende dunkle Zwischenraum, beginnt beim Kern selbst und ist scharf begränzt. Seine Breite beträgt im Anfange 12″, die Richtung der vorangehenden Seite wurde gemessen zu 5°.3, die der nachfolgenden Seite zu 10°.8."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen*, 1858, pp. 20, 21.)

"19^h 33^m Sternz. D = 2″.69. 2 Beob.

"Kern ziemlich scharf begränzt und mit schwächerer Vergrösserung schwer von dem sehr hellem Lichte des innern Sector zu unterscheiden. Die Helligkeit desselben im Sucher ist bei weitem geringer, als die von Cor Caroli, gar nicht nach Art der veränderlichen Sterne durch Stufenschätzung vergleichbar; der Unterschied beträgt wohl $\frac{3}{4}$ Grössen."

(Ibid., pp. 23, 24.)

"19^h 20^m Sternz. Die Excentricität des Kernes gegen die Sectoren, in der Richtung (beiläufig) senkrecht auf den Schweif, hat sich sehr verkleinert; er war mit schwächerer Vergrösserung von dem sehr hellen Lichte des innern Sector schwer zu unterscheiden. Dieser letztere erschien mir ziemlich gleichmässig hell; wenn eine Differenz vorhanden war, so möchte die vorangehende Seite die hellere sein. Die Begränzung des Sectors war scharf abgeschnitten nach allen Seiten. Unmittelbar daran schloss sich ein zweiter, nahezu symmetrischer Sector von schwächerm Lichte, dessen Intensität aber noch die des Schweifes in seinen hellsten Theilen übertraf. Die Begränzung dieses Sectors bestand aus einem beträchtlich hellern, nach aussen sehr scharf abgeschnittenen Ringe von 4″ Breite. Ob davor ausser der schwachen Umhüllung noch Nebelmasse war, wie eine gleichzeitig entworfene Skizze zeigt, erinnere ich mich nicht bestimmt.*

"Abstand des Randes des hellen Sectors vom Kerne in der Richtung des Schweifes d = 11″.8. 2 Beob.

Abstand des äussern Randes des Ringes vom Kerne in gleicher Richtung: d = 26″.5. 3 Beob.

* "Diese Notiz wurde 9^h Abends niedergeschrieben; am Morgen heiterte es sich wieder auf und ich finde zu dieser Stelle bemerkt:

"17^h 12^m Mittl. Zeit. Vor dem zweiten Sector ist allerdings noch Nebelmasse und ich schätze die Breite derselben zu $\frac{1}{3}-\frac{1}{4}$ des Abstandes der beiden Sectoren von einander, also 4″–5″; und ferner hierzu am 30 Sept.:

"Dies ist doch wohl ein Irrthum; heute ist ausser der schwachen Umhüllung *vor* dem zweiten Sector bestimmt kein Nebel."

"Es bewölkte sich leider so rasch wieder, dass die Zeit nicht hinreichte, auch uber die äussere schwächere Umhüllung etwas zu ermitteln."

(Ibid., pp. 30, 31.)

"19^h 45^m Sternz. $p = 14°.64$. 6 Beob.

"Der fast schwarze Streif in der Mitte des Schweifes, der jetzt erheblich mehr hervortritt, als zu Anfange seiner Erscheinung, war sehr auffallend. Die Richtung desselben fällt nich völlig mit der des Schweifes zusammen, sondern der Positionswinkel ist etwa 5° kleiner, also $p = 11°$. Seine Dunkelheit wird je näher zum Kopfe, je grösser und unmittelbar am Kerne ist diese Zone nicht viel heller, als der umgebende Himmelsraum, wobei jedoch die Wirkungen des Contrastes zu berücksichtigen sein werden."

1858. September 30. (Plates XXXIV. and XLIX. 37-41.)

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 216.)

"September 30. En ugunstig Aften; kun nogle lyse Intervaller tillode at betragte Kometen, som paa samme Dag gik igjennem Periheliet i omtrent 0.5786 Afstand fra Solen. Det nye Hylster, tilligemed den nye igaar Aftes iagttagne Hale, var atter forsvunden. De to Grændseradier af den lysende Sektor havde imidlertid, og mere end det nogensinde foer havde været Tilfældet, nærmet sig hinanden, og det var i Aften œiensynligt, at Halen nu var ifærd med at afsondre sig i to Dele eller nœiere i to adskilte Grene. Man see iœvrigt Fig. . . . " (Plate XLIX. 41.)

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"The edge of the envelope C is very distinct, and may be traced through an angle of 270°, reckoned from the nucleus. The latter is truncated, as it has often before been seen, on the side opposite to the sun, giving it a half-moon shape. The dark axis, which at its origin is almost black, and is of even breadth with the nucleus, completes the resemblance to a phase and shadow." The inner envelope C is very bright, but curdled, as it were, with an evident ray towards a point indicated in a sketch. There is another ray on the opposite side.

The dark axial stripe had its origin always precisely at the nucleus, which on this side was sharply defined when best seen.

CAMBRIDGE, ENG. BREEN. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 17.)

"The nucleus again large and planetary; no fantail, but a little rainbow over the nucleus, as on Sept. 27. Dark band sharply defined down the tail; the outer boundary of the tail sharp on the right side, and ill defined on the opposite side. By measurement with the position circle, the axis of the tail was inclined southward from the great circle through the pole by 13°."

CAMBRIDGE, ENG. CHALLIS. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 18.)

"'In the finder a narrow, dark band well defined was observable along the axis of the tail.' My drawing (Plate XLIX. 39) represented the central brightness as larger and more oval than on Sept. 27, and having a round, blunt termination at the lower or brightest part. Above the upper part was a less illumined space, increasing in brightness towards a luminous semicircular arch, pretty definitely bounded on the outside, beyond which the coma was faintly visible to some extent. This arch descended towards the tail a little more on the right side than on the left. The tail appeared to stream both from the arch and from the exterior and interior coma, and the right hand stream was considerably the brighter."

FLORENCE. DONATI. (*Bulletin Obs. Imp. de Paris.*)

"Du 23 au 30 septembre, le noyau paraissait entouré (du côté opposé à la queue) d'un demi-cercle nébuleux très-clair, auquel succédait un autre demi-cercle dont la lumière était beaucoup plus faible que celle du premier. Venait ensuite une nébulosité indéfinie à laquelle se rattachait la queue qui était longue d'environ 25°. Diamètre du noyau le 30 Septembre, 3″.0."

MARKREE. GRAHAM. (*Obs. of Donati's Comet* 1858, *Markree*, p. 9.)

"The convex portion (southern) of the interior envelope, next to the nucleus, was equally well-defined with the 28th; the N. portion was more concave. This latter phenomenon was remarked by Mr. C. Robertson and myself independently. The cusps of course seemed longer and more acute, — the eastern or following one more lengthened than the preceding or western.

"Mr. Cooper . . . . . remarks, that the nucleus is more sharply defined than in any other comet he ever saw, and that in shape it takes very much the character of the interior envelope, which exhibits the remarkably definite phase, though the nucleus is not so well defined as the envelope. . . . . .

"On the concave side of the crescent, the line of direction curves slightly from the nucleus as from a cusp, something in the form of Halley's Comet, of 20th October, 1835, though not so much curved. To my eye there was a narrow, dark line between the nucleus and the first envelope on the S. side, inclined a little towards the S. preceding; this was also the impression of Mr. C. Robertson. . . . . . Mr. Cooper remarks, that the extent of the nucleus towards the middle of the convex part of the crescent, measured from the brightest or N. part southward, was not quite half the middle radius of the first envelope."

YORK, ENG. GRAY. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 27.)

"The second stratum has its crescent prolonged on the following side."

"In the finder ... of the tail. ... larger ...

... the axis ... brightness as ... at ... space, ... from the exterior and ... the brighter."

... côté opposé à la queue) ... demi-cercle dont la ... ensuite une ... d'environ

... to the nucleus, ... concave. This ... and myself independently. ... the eastern or following

... more sharply defined than in ... the char- ... though

... slightly from ... of 20th ... narrow, dark ... inclined a little ... Robertson. . . . . the middle of the ... N. part southward,

... p. 27.)

... following side."

COMET OF DONATI 1858.

SEPTEMBER 30TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE. PLATE XXXIV

G.P. Bond Del. J. W. Wats Sc.

COMET OF DONATI 1858.

OCTOBER 2ND 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE. PLATE XXXV

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LIVERPOOL. HARTNUP. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 56.)

"Diameter of nucleus, 17″.

Diameter of first envelope, 2′ 1″.

Distance from centre of nucleus to front of coma, 1′ 26″.

Diameter of coma at right angles to tail, measured through centre of nucleus, 5′ 46″.

Length of tail measured along the curve on the convex side, 26° 35′.

Distance from nucleus to end of tail in a straight line, . . 26° 0′.

Greatest diameter of the tail, 3° 10′. . . . . .

"A well-defined conical shadow was visible, the length of which, measured from the nucleus or the base of the cone to the apex, was 18′. . . . . .

"The tail of the comet was more symmetrical and the envelope was brighter and better defined than on any other occasion."

DORPAT. MÄDLER. (*Beob. der Kaiserl. Sternw. Dorpat*, XV. p. 43.)

"Zu Anfang heiter und ziemlich windstill. Der Kern erschien auffallend klein, so dass er kaum noch messbar war. Ich mass: $18^h\ 28^m$ . . 1″.766.

"Später bei grösserer Dunkelheit: $19^h\ 14^m$ . . 1″.578.

"Dabei ist er besser begrenzt als an den vorangegangenen Abenden. Die Ausstrahlung wie gestern, aber gegen 19^h wird zuerst ein kurzer feiner Strahl bemerkt, vom Kopfe nach N. W. (Richtung 320° 2′) ziehend, und der Raum zwischen ihm und dem vorangehenden Theile der Ausstrahlung merklich heller als auf der andern Seite des Strahls, wo sich ein dunkler Quadrant bildet. Von diesem dunklen Raume auszog sich eine dunkle Spalte durch die Mitte des Schweifes. Im Verlaufe des Abends wird es an der Westseite des Strahls immer heller und zuletzt der innern Strahlenkrone fast ganz gleich. Für die Richtung der Ausstrahlung (abgesehen von dem erwähnten hellen Nebenraume) fand sich: $18^h\ 37^m$ . . 167° 15′, $18^h\ 51^m$ . . 168° 0′.

Der innere hellste Theil der Ausstrahlung: Halbm. $18^h\ 46^m$ . . 14″.443

Der äussere Umfang des Ringes: Halbm. $18^h\ 56^m$ . . 33″.627

Richtung des Schweifes: $19^h\ 1^m$ . . 18° 34′"

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, pp. 313, 314.)

"Am folgenden Abend, Septbr. 30, war das 3½ füssige Aequatoreal mit einem Positions-Micrometer versehen, durch welches unmittelbar die Messung der Richtungslinien des Schweifes und der Ausströmung ausgeführt werden konnte.

"$7^h\ 0^m$ trat der Comet zwischen Wolken hervor. Kern und Ausströmung waren ausserordentlich hell. Letztere bildete einen gleichmässig hellen, scharf begrenzten Sector von etwa 220°. Jedoch gestattete die kurze Sichtbarkeit des Cometen nicht,

eine genaue Zeichnung zu entwerfen. Die Messung der Richtungen ergab um $7^h\ 5^m$:

Pos. Winkel der Mittellinie des Sectors = 192°.
" " " " Schweifes = 16°."

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 262.)

"Der Kern des Kometen erscheint heute wieder etwas grösser und nicht ganz rund; der Hinterrand ist gut begrenzt und abgerundet, der Vorderrand ist aufgetrieben."

COLLEGIO ROMANO. SECCHI. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 13.)

"Direzione dell' asse della coda $13\frac{1}{2}°$: anche oggi questa direzione è diversa da quella di una linea media che si imagini condotta pel mezzo dell' angolo oscuro del ventaglio, che si trovò esser 38° 26′, onde l' apertura di quest' angolo non infilava nella direzione della coda. Questa sera la distanza massima delle due punte del ventaglio era 47″.4, cioè un poco meno di ieri sera, e l' asse maggiore del nucleo 8″.72, cioè un poco più della sera precedente."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 5, 6.)

"Das Aussehn des Cometen hat sich seit gestern wenig verändert. Zwischen $18^h\ 50^m$ und $19^h\ 40^m$ wurden folgende Schätzungen und Messungen erhalten.

1. Am Facher.

Vorangehende Spitze, Richtung 313°, Abstand 10″.
Nachfolgende " " 83°, " 20″.
Abstand auf dem Parallel des Kerns, vorangehend 13″.
" " " " nachfolgend 16″.
Vorangehende Spitze des innern Fächers, Richtung 247°, Abstand 13″.
Nachfolgende " " " " 155°, " 13″.

2. Am Halbbogen.

Richtung der Tangente in der Mitte, 94°.
Abstand in der Mitte, $2^r.95$ = 28″.8.
" auf dem Parallel des Kerns, vorangehend, $3^r.23$ = 31″.5.
" " " " nachfolgend, $4^r.08$ = 39″.7.
Breite des dunklen Zwischenraums zwischen Fächer und Halbbogen = 6″.

"Die Richtung der vorangehenden Seite des dunklen Zwischenraums zwischen den beiden Schweifhälften wurde heute gemessen zu 9°.0, die der nachfolgenden Seite zu 17°.3."

(Ibid., pp. 6, 7.)

"Abstand des Kerns von der Südspitze des Cometen 45″.
" " " äusseren Begränzung des Cometen auf dem Parallele des Kerns, vorangehend, 60″.

Abstand des Kerns von der äusseren Begränzung des Cometen auf dem Parallele des Kerns, nachfolgend, 80″.

"Der schwache südliche Nebeldunst hatte seine Hauptrichtung unter 169° und konnte in derselben bis auf 8′ Abstand vom Kern verfolgt werden.

"Zur Bestimmung der Dimensionen des Cometen in der Nachbarschaft des Kerns und der anfänglichen Richtung des Schweifs können noch folgende Beobachtungen über die Stellung des Vergleichsterns in der Nebelmasse dienen.

"Um	19^h	42^m	12^s	Pulk. Stzt.,	Vergleichstern	am nachfolgenden Rande des Schweifs.
"		52	10	"	"	in der Mitte der nachfolgenden Schweifhälfte.
"	20	3	58	"	"	am nachfolgenden Rande des dunklen Streifen.
"		10	1	"	"	am vorangehenden Rande des dunklen Streifen.
"		29	53	"	"	am vorangehenden Rande des Schweifs.

"Die nachfolgende Begränzung des Schweifs erschien durchweg sehr scharf, während die vorangehende schon in wenigen Minuten Entfernung vom Kern sehr verwaschen war, indem das Licht allmälig abfiel. Aus diesem Grunde kann die letzte Zeitangabe nur auf eine vergleichsweise geringere Genauigkeit Anspruch machen."

TRETIRE. WEBB. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 22.)

"When I perceived it [the envelope] on the first trial of the $5\frac{1}{2}$-inch object-glass, the portion next the sun was least luminous, and seemed to consist chiefly of a narrow arc of light, indicating a hollow structure; this bright ring became more evident at a greater distance from the sun, so that the portions adjoining the central darkness were most conspicuous, especially, perhaps, that on the preceding side, according to the Comet's orbital motion. . . . . .

"The proportion of the dusky streak to the whole breadth of the tail was estimated at $\frac{1}{8}$."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 21.)

"18^h 48^m Sternz. D = 2″.04. 3 Beob.

"Der Comet ist 36^m nach Sonnenuntergang schon vortrefflich dem blossen Auge sichtbar. Kern gut begränzt im Fernrohre; Messungen mit 335f. Vergr. Im Cometensucher zeigt er sich bedeutend schwächer als Cor Caroli."

(Ibid., p. 24.)

"18^h 50^m Sternz. Der innere Sector ist über 252°.3, 3 Beob., ausgebreitet; die

absolute Richtung seiner Begränzungen nach links und rechts lässt sich aus den Einstellungen nicht ableiten, weil der Nullpunkt nicht bestimmt wurde. Eine halbe Stunde später erhielt ich:

Positionswinkel Kern bis äusserste Spitze des innern Sectors rechts 70°.3. 2 Beob.
" " " " " links 328°.3. 2 Beob.

Ferner wurde gefunden $d = 14''.4$. 3 Beob.
$d' = 26''.3$. 3 Beob.

"Letztere Messung ist weniger sicher als gestern, weil es schon ziemlich dunkel wurde. Die Bedeutung der Buchstaben ist dieselbe, wie Sept. 29; ich werde diese Bezeichnung auch im Folgenden anwenden.

"Schwache Umhüllung: Richtung der Aufblähung 164°.6. 1 Beob., Abstand vom Kerne in dieser Richtung 4'.7.

"Abstand vom Kerne in der dem Schweif entgegengesetzten Richtung 4'.3.
In der Richtung senkrecht hierauf durch den Kern folgend 5'.3.
" " " " " vorgehend 3'.5.

"Im Cometensucher war sie trefflich zu sehen und ihre Farbe erschien darin im Vergleich zu dem gelblichen Lichte des Schweifes und Kopfes bläulich. Contrast?"

(Ibid., p. 31.)

"19h 55m Sternz. $p = 17°.44$. 5 Beob.

"Die schmale dunkle Zone theilt den Schweif in zwei ungleiche Hälften, so dass die vorangehende die kleinere ist; den Positionswinkel derselben ergaben drei Einstellungen zu 15°.1. . . . . .

"Die schwache Umhüllung steht von der hellen ab:

Entfernung vom Kopfe: 5' vorgehend: 2' folgend: 4'.0.
" " 10' " 1' " 2'.3.

In 26' Abstand nicht mehr bestimmbar.

"Das allmälige Auslaufen der vorangehenden Schweifseite und die viel schärfere Begränzung der folgenden wird immer auffallender."

VIENNA. . . . (*Annalen der k. k. Sternw. in Wien*, F. III. IX. p. 178.)

"Der Kern erschien sehr intensiv, klein und beinahe rund. Er war von einem nebelhaften Gebilde umgeben, das einem weitgeöffneten Fächer glich, und die übrigen Theile des Cometennebels an Helligkeit weit überstrahlte. Dieser Fächer war an der der Sonne zugekehrten Seite ziemlich scharf begrenzt, während an seinen beiden von der Sonne abgewandten Ecken die Lichtmaterie allmählig in den Schweif überging. Die Mittellinie des Fächers war gegen die Richtung vom

Kerne zur Sonne beträchtlich geneigt, und zwar nach links (im umkehrenden Fernrohre). Den ganzen Kopf des Cometen umgab noch ein äusserst feiner Lichtnebel, der mit zunehmender Entfernung vom Kopfe allmählig schwächer wurde."

1858. October 1. (Plate XLIX. 42, 43.)

An increased divergence of the branches of the tail begins now to attract notice. The excess of brightness on the right branch had probably passed its maximum at this date.

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 216.)

"En endnu stærkere Forandring foregaaet i Lyssektoren, hvis Grundradier nu omslutte henved 330 Grader. Saavidt det, under Savnet af et dertil passende Maaleapparat, kunde skjønnes, manglede der netop paa den Solen modsatte Side et Udsnit paa tredive Grader. Særdeles mærkeligt var det, at der lige fra Kjærnen udgik en smal, meget snever *mørk Stribe*, saa paafaldende sort, og i Særdeleshed paa den høire Side (i Kikkerten) saa skarpt begrændset, at den aldeles gjorde Indtrykket af en *Skygge*. Denne Stribe var omtrent 30 Bueminuter lang. Iøvrigt var det svage Skjær omkring Kometens Hoved, dette tredie eller maaskee fjerde Hylster, som efterhaanden tilsyneladende havde udsondret sig fra Kjærnen, atter ligesaa godt synligt som de foregaaende Aftener."

HIGHBURY, ENG. BURR. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 26.)

"The nucleus had become brighter, but smaller, with projecting wings or jets of light sweeping backwards."

PARIS. CHACORNAC. (*Bulletin Obs. Imp. de Paris.*)

"Un fait remarquable au sujet de l'excentricité des enveloppes, c'est que depuis le 23 septembre jusqu'au 1er octobre, le noyau était, dans le sens du diamètre perpendiculaire à la queue, plus voisin de la limite australe de ces enveloppes que de la limite boréale; tandis qu'à dater du 2 octobre c'est le contraire qui a lieu; le noyau est plus voisin de la limite boréale et c'est aussi cette partie des enveloppes qui est maintenant la plus lumineuse et la plus etendue."

FLORENCE. DONATI. (*Bulletin Obs. Imp. de Paris.*)

"Le 1er octobre, le demi-cercle sombre dont j'ai parlé avait presque disparu; l'auréole lumineuse qui entourait le noyau s'était dilatée et atteignait presque l'autre auréole plus faible. Il n'y avait plus entre elles qu'une légère ombre estompée. Ces deux auréoles formaient presque deux cercles complets, à l'exception d'une échancrure d'environ 60° du côté de la queue."

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, p. 314.)

"6^h 30^m ward es klar und anhaltend, so dass ich den Cometen bis zum Unter-

gang verfolgen konnte. Der Anblick war gegen gestern Abend gänzlich verändert. Der Ausströmungs-Sector umfasste einen Bogen von nur 160°, sein Radius war erheblich kleiner geworden und betrug etwa 12″ – 15″; jedoch war seine Helligkeit ausserordentlich. Die über ihm liegende parabolische Zone war ähnlich wie Sept. 28, ihr Scheitelradius betrug etwa 35″. Der innere Sector war gegen diese Zone sehr scharf abgegrenzt, ebenso die letztere gegen die äussere Umhüllung die bis zu 3′ Abstand vom Kern zu verfolgen war. Auffallend war es, dass die beiden Aeste des Schweifs, welche die Fortsetzung der mittl. Zone bildeten, stärker gegen einander geneigt waren, als Sept. 28. $8^h\ 27^m$ erhielt ich:

Pos. Winkel der Mittellinie des Sectors = 218°.25.
" " " " Schweifes = 18°.75."

Kremsmünster. Reslhuber. (*Astron. Nachrichten*, 1169, p. 262.)

"Es bildet sich, wie es die Beobachtung Oct. 1 bestätigte, durch Ausströmung aus dem Kerne eine neue denselben zunächst umgebende nach hinten offene Einhüllung; die am 28 Sept. ausgeschiedene Enveloppe nimmt eine mehr elliptische Krümmung an, mit einer in der Weite von 35 Graden der Peripherie des Kernes offenen Stelle auf der Rückseite."

Oxford, Eng. Slatter. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 24.)

"*Nucleus* not round, irregular oval; perhaps paraboloidal. Larger diam. 12″, smaller 9″.

"*Parabolic Envelope* distinct and bright, the shape of its posterior boundary not noticed, but in a rough sketch it descends a little below the nucleus. Measuring through the nucleus, i. e. if parabolic, the parameter = 4′.1."

1858. October 2. (Plates XXXV. and XLIX. 44 – 47.)

The opposite sides of the envelopes are more symmetrical as to form and brightness than hitherto, and have their axes nearly in the same direction with the axis of the tail. These changes should be compared with the alteration which soon followed in the relative brightness of the two branches of the tail. Notwithstanding some contradictory evidence, I am inclined to think that no new envelope had, as yet, been detached, although the brilliancy and form of the nucleus suggested that one was close at hand.

Greenwich. Airy. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 12.)

"The night favorable. The Comet's head much brighter than *Arcturus*. . . . . .

"The signs of polarization were quite distinct, though much less strong than on a previous evening. On viewing the head with the Sheepshanks telescope it had this appearance: —

"1st. The parabolic envelope and enclosed illumination. 2d. A brighter, flat,

circular disk (with no special ring of brightness) laid upon the enclosed illumination, just touching the parabola at its vertex. 3d. A still brighter, flat, circular disk, concentric with the last, about one fourth of its diameter; no bright ring. 4th. The nucleus, concentric with the last, about one third of its diameter, well defined, and looking very hard. From the nucleus a dark shadow diverged, with an angle at first of 30° or more, diminishing afterwards to 10° or 15°, cutting off the light of the circular disks and everything except the nucleus itself."

Observatory of Harvard College. G. P. Bond.

"A fine, clear night. Observations began at 6^h. The following measurements were taken:—

Diameter of nucleus perpendicular to axis, . . . 5″.2

This may be a little too large on account of atmospheric disturbance.

Transverse diam. of bright envelope *C* in the direction *c c*″ . 63″.2

I see no new one forming as yet, although the nucleus may be rounded on the side next the sun.

Transverse diam. of envelope *B* in the direction *b b*″ . . 110″.2

Nucleus to vertex *c*′ of inner envelope *C* . . . 24″.9

Edge of envelope very distinct.

Nucleus to the vertex *b*′ of envelope *B* . . . . 43″.9

The darkest part of the interval between the second and inner envelopes, *C* and *B*, is close to the outer edge of *C*, and is 5″ broad.

The angle between the tangents of the outer margin of the tail at 6′ to 8′ from the nucleus . . . . . 31°

Angle of position of the following side of the dark stripe in the axis of the tail . . . . 25° 7′

Breadth of tail at 8′ from nucleus . . . . . . 5′

Breadth of dark stripe in the axis at 30″ from nucleus is about 6″

"The following side is well defined, the preceding less so. Its outlines seem to terminate in contact with the nucleus, and there is no sensible curvature of outline up to the point of contact. This was carefully examined. On the preceding side the vision was distracted by a ray issuing from the nucleus in the direction of the angle of position 338° 35′.

"I can scarcely discern any nebulosity beyond a distance of 2′ from the nucleus towards the sun, and there is very little beyond 1′ 30″. The nucleus is large and very intense, like a star of the second magnitude. It certainly appears rounded on the side next the sun, and truncated on the opposite side. Expect-

ing a new envelope, I looked very carefully for symptoms of it, but none were apparent. The following edge of the dark stripe was found, by placing the wire of the finder against it, to be perfectly straight. In the comet-seeker the central darkness is on the faint preceding side of the tail, and does not curve. Seen in the great telescope, the outlines are straight lines near the nucleus, but at a little distance they begin to blend with the general deficiency of light in the middle of the tail. The outlines of the envelopes *penetrate* the bright light behind the nucleus, so that the tangents to these outlines do not correspond with the general direction of either of the two branches of the tail. There are three decided dark openings in the envelope *C*." Several sketches were made.

Highbury, Eng. Burr. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 26.)

"A fine, dark division in the tail was apparent, reaching from the head for about a degree in length, which subsequently became wider and larger."

Cambridge, Eng. Challis. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 18.)

"About the very bright and small nucleus on the upper side was a bright fan or hood, and beyond this a larger hood, with a less-illumined space between them. The coma was traceable beyond the second hood. Under the cusp of the nucleus the space was remarkably dark, and a dark and rather broad band divided the tail into two parts, which, at a considerable distance from the head, overlapped each other. A drawing (Plate XLIX. 45) represented the right-hand branch of the tail considerably the brighter, but the form and appearance of the head was now symmetrical about its axis."

Florence. Donati. (*Bulletin Obs. Imp. de Paris.*)

"Le 2 octobre, le noyau était environné d'une petite auréole très-brillante de la largeur d'environ 1″. Avec les faibles grossissements cette auréole se confondait avec le noyau."

Vienna. Hornstein. (*Annalen der k. k. Sternw. Wien*, F. III. IX. p. 178.)

"Am 2 October hatte der Kern, ohne beträchtlich grösser geworden zu sein, eine fächerartige Gestalt angenommen; die dunkle Mittellinie zwischen beiden Aesten des Schweifes war sehr gut sichtbar, und auf eine beträchtliche Entfernung vom Kerne zu verfolgen."

Dorpat. Mädler. (*Beob. Kaiserl. Sternw. Dorpat*, XV. p. 44.)

"Nach heftigem Regen erfolgte um $8\frac{1}{2}$ Uhr Abends eine Aufheiterung bis gegen 9. Der Comet stand schon zu tief für genaue Untersuchungen; die Ausstrahlung im Allgemeinen wie an den letzten Abenden. Nur der Halbmesser des Ringes erschien noch messbar; ich fand $21^h\ 43^m$ . . . . 26″.460."

Greenwich. Main. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 13.)

"The nucleus has a very bright stellar point, and is surrounded by a brightness similar to a planetary disk of 5″ or 6″ in diameter; the circle of the disk is not complete, its lowest part being cut off, through an angle of about 60° or 70°, by a well-marked shadow, commencing immediately below the stellar point, continuing downwards, as seen inverted, in the direction of the train, and inclined at an angle of several degrees to the axis of the envelope. Surrounding the planetary disk is an annulus of light, about four times its diameter, considerably fainter, but brighter than the envelope generally, and about two thirds complete, the lower part being obscured by the same shadow which cuts off a portion of the inner disk; its circumference is exceedingly well defined and of uniform brightness, excepting when it is immediately in contact with the inner annulus, where, perhaps from the effect of contrast, it appears dark."

Altona. Pape. (*Astron. Nachrichten*, 1172, p. 314.)

"Der folgende Abend, Octbr. 2, zeigte keine wesentliche Veränderung; der Radius und der Umfang des Ausströmungs-Sectors schien mir noch kleiner als Octbr. 1.

Die Messungen ergaben folgende Positions-Winkel: um $7^h\ 0^m$ Sector $= 216°.25$.
Schweif $= 20°.25$.

"Ich habe nicht immer bemerkt, dass der Pos.-Winkel des Schweifes sich auf die Mitte der früher erwähnten dunklen Zone zwischen beiden Schweifästen bezieht; auch die nachfolgenden Messungen gelten für diese Zone."

Observatory of Hamilton College, Clinton, N. Y. Peters. (*Mss.*)

"Perceived the well-defined shadow of the nucleus, a dark streak, stretching out in a straight line, sensibly deviating from the axis of the tail towards the right (in the inverting telescope); its width is exactly the diameter of the nucleus, say 3 or 4 seconds. It is blackest near the nucleus, and grows dimmer with the distance almost in the same proportion as the surrounding matter of the tail. I can trace it for about half a degree."

Madras. Powell. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 64.)

"Nucleus large and bright, but ragged; not so bright as *Arcturus*, but considerably brighter than η *Ursæ Majoris*. The eastern or convex edge of the envelope sharper and brighter than the other."

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 13.)

"Le apparenze da questo giorno in poi sembrano aver preso un carattere tutto diverso dai giorni precedenti. La cometa ha tre inviluppi ben distinti, il più lontano è una nebulosità diffusa, il secondo è più lucido più deciso ed è simile al

nimbo che si dipinge attorno ai Santi dai pittori del trecento ed è di forma circolare che tende a rientrare in se stesso senza ripiegarsi per secondare la coda, il terzo è una specie di alone o aureola formata attorno al nucleo, e che vedesi distintamente separata dall' inviluppo intermedio da uno spazio meno luminoso; 'L' intensità di questo ventaglio va crescendo dalla periferia al centro, ove si confonde col nucleo; la sua forma è rotonda, ma mancano circa 90 gradi a chiudersi. Esso è fornito di due raggetti o piccole code, e quello al sud apparente non è in linea retta ma ricurvo verso Nord-Ouest. Quest' aureola non è rigorosamente circolare, ma più allungata al Sud apparente che al Nord. Il grande ventaglio (nimbo) è simmetrico rapporto al piccolo, anche rispetto alla curvatura dell' esterno raggio al Sud apparente.'

"Quest' aureola fu veduta anche dal Signor Donati quasi lo stesso giorno formassi attorno al nucleo della Cometa; onde anche qui combinano le apparenze. Esse sono importanti, perchè sono una riproduzione delle aureole vedute tante volte attorno ai nuclei e descritte da Lemonier nell' *Hist. Céleste,* 1680, pag. 243 (ma la fig. ricopiata da Delambre nella sua astronomia è mal disegnata) come pure quelle di Messier riportate da Arago, *Astr. Popul. loc. cit.*"

1858. October 3. (Plate XLIX. 48-52.)

A new envelope, *D*, is now distinguished, with a well-defined and conspicuous dark spot on its surface. This is a very interesting development in its bearing upon the question of the rotation of the nucleus or envelopes.

Greenwich. Christy. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 13.)

"The appearance of the comet is generally similar to that of last evening. The inner disk, however, appears larger; and on its surface is a well-defined dark spot, about the same size as the nucleus, situated a little to its left, in the direction of the comet's diurnal motion."

Florence. Donati. (*Bulletin Obs. Imp. de Paris.*)

"Le 3 octobre, la petite auréole nébuleuse du jour précédent s'était dilatée; sa largeur était de 4″.8. L'auréole suivante était beaucoup plus large dans le sens perpendiculaire à la queue que suivant sa direction; son rayon était de 34″.0 dans le premier sens, et de 30″.4 dans l'autre. Diamètre du noyau 2″.9."

Christiania. Fearnley. (*Astron. Nachrichten,* 1242, p. 273.)

"Den Kopf habe ich am vollständigsten am 3^{ten} Oct. mit dem 7 zölligen Refractor untersuchen können. Es war eine prachtvolle und höchst interessante Erscheinung. Früher hatte ich den Cometen nur am Aequatoreal und am 5 zölligen Refractor beobachtet, und daher mag es wohl kommen, dass ich erst an diesem

Abend mit dem grösseren Instrument die sehr deutliche Excentricität in der Lage der beiden den Kern umgebenden Nimben erkannte. Bisher hatte ich ihre Grenzlinien als mit dem Kern concentrische Kreise aufgefasst; jetzt war es aber nicht zu verkennen, dass die scheinbaren Mittelpunkte des Kerns des ersten (inneren) und zweiten Nimbus auf einander folgten in der Richtung des Radius-Vectors. Vielleicht ist es diesem Umstande zuzuschreiben, dass mir besonders der äussere Nimbus auch etwas elliptisch vorkam (die grosse Achse in der Richtung des Rad. vect.). Wegen der nicht geschlossenen Figur konnte ich darüber nicht, weder an diesem Abend noch später, ins Reine kommen. Der merkwürdige dunkele Flecken war ein sehr auffallendes Object (ich erinnere nicht gesehen zu haben, dass er von anderen Beobachtern vor dem 4ten Oct. bemerkt worden ist), und ich hätte ihn gewiss auch im 4 zölligen Fernrohr des Aequatorials, an dem ich kurz vorher beobachtet hatte, denselben Abend (Oct. 3) sehen können, wäre nicht meine Aufmerksamkeit bei der Beobachtung an demselben fast ausschliesslich auf die Messungen gerichtet gewesen. Der Flecken kam mir bei der ersten Wahrnehmung fast eben so dunkel vor, als der innere Theil der schwarzen Spalte, erschien kreisrund, von der Grösse des Kerns, und war auf dem Parallel desselben etwa 7 Bogensecunden vorangehend, indem er sich gerade in der Mitte zwischen dem Kern und dem vorangehenden Rand des ersten (inneren) Nimbus befand."

(Ibid., p. 274.)

"Ein leichter bläulichen Nebel umgab die Coma, aber unsymmetrisch (vergl. Prof. *Galle's* Beob. Oct. 4) etwa wie eine spitzige Capuze schief auf den Kopf gesetzt. Zur besseren Verständigung der hier beschriebenen Erscheinungen vom 3ten Oct. lege ich einen einfachen Riss bei (Plate XLIX. $52_{(a)}$), worin ich stellenweise auch die Lichtabstufungen angedeutet habe."

Breslau. Galle. (*Astron. Nachrichten*, 1179, p. 39.)

"Der ganze Schweif war, von dem sehr helle Kerne an, in zwei Hälften getheilt, welche durch einen dunkleren Zwischenraum von einander getrennt waren. Im Cometensucher erschien der Zwischenraum als eine scharfe schmale dunkle Linie (einem vom Kern geworfenen Schatten ähnlich), im Fernrohr etwas breiter und mit verwaschenen Grenzen. Dieser dunkle Streifen wurde in einiger Entfernung vom Kopfe breiter, liess sich jedoch nur einige Grade nicht bis an das Ende des Schweifes verfolgen, wo dann der Schweif in seiner ganzen Breite ein nahezu gleichförmig verwaschenes Ansehen hatte und nur die hellere Mitte des linken Zweiges etwas überwiegend blieb. Der linke Zweig, der dunkle Streifen und der rechte Zweig verhielten sich in der Nähe des Kopfes rücksichtlich ihrer Breite = 3 : 1 : 2."

YORK, ENG. GRAY. (*Monthly. Notices Royal Astr. Soc.*, Vol. XIX. p. 27.)

"The first stratum is a sector of 240°, a dark, well-defined space between the branches of the tail, a black spot distinct on the preceding side of the glowing nucleus, and on the second area I was under the impression that a similar spot, very faint, existed. (I did not see the latter spot on subsequent evenings, but the spot on the first area was always visible.)"

NEUCHATEL. JEANJAQUET. (*Souvenirs de la Comète de* 1858, p. 11.)

"Le dimanche 3 octobre, après une journée sans nuages, crépuscule splendide. La ligne sinueuse des montagnes, du côté où le soleil a disparu, se dessine dans un ciel tout d'or et du feu. Il est 6 heures; nous essayons de voir si la comète, vu la pureté de l'atmosphère, serait peut-être déjà perceptible. Après quelques instants de recherches, nous la découvrons excessivement petite et pâle, et toujours de cette blancheur argentée d'une planète vue en plein jour."

MUNICH. LAMONT. (*Jahresbericht der k. St. bei München*, p. 18.)

"Am 3 Oct. erschien der Komet in der Gestalt Fig. . . . (Plate XLIX. 49.) Die äusserste parabolische Begrenzung des Kopfes war nur mit Mühe sichtbar; die zweite Begrenzung sehr deutlich. Die unmittelbar vom Kern ausgehende Dunstmasse bildete ebenfalls eine parabolische Figur, parallel mit den zwei äusseren Begrenzungen. Um die Beschaffenheit des Kometenkopfes genauer zu erklären, habe ich ein Gerippe desselben in Fig. . . . (Plate XLIX. 50) gegeben; *a a a* ist die äusserste sehr schwache, *b b b* die zweite stärkere parabolische Begrenzung; die dritte parabolische Begrenzung *d f g* umschliesst den zunächst vom Kerne gegen die Sonne sich erhebenden Dunst. Die Dunstausströmung ging aber keineswegs von allen Puncten des Kerns mit gleicher Intensität vor sich, vielmehr konnte man in der Dunstmasse einzelne hellere Ströme unterscheiden, welche aus dem Kerne, mehr oder weniger nach ihrer Neigung gegen den Radius Vector gekrümmt bis zu der Grenzlinie *d f g* hinausgingen. Unter den einzelnen Strömen zeichneten sich zwei besonders aus, *c p* und *c q*. Der erstere Strom hatte eine kleinere, der zweite eine grössere Krümmung, und ihre Enden vereinigten sich *perspectivisch* (denn ohne Zweifel lagen sie in verschiedenen Ebenen) in *d*, so dass in der Mitte ein relativ dunkler Raum übrig blieb. Dies ist der schwarze Fleck, welchen Herr *Donati* am 4 und 5 Oct. gesehen hat."

BRADSTONES, ENG. LASSELL. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 79.)

"The Comet was surveyed in the 20-foot equatorial from about $6\frac{3}{4}$ to $7\frac{1}{4}$ hours. The following measures were taken along an imaginary line drawn through the nucleus at right angles to the direction or axis of the tail: —

Diameter of nucleus,	. .	6″.74
" " 1st envelope,	. .	30″.11
" " 2d envelope,	.	102″.2."

Geneva. Plantamour. (*Note sur la Comète de Donati*, p. 7.)

"Le 3 octobre, à 7 heures du soir, l'apparence de la comète avait changé considérablement. Le noyau était très-brillant, un peu allongé dans la direction du soleil; il était entouré d'enveloppes paraboliques lumineuses, dont le noyau était le foyer, et dont l'éclat allait en décroissant de l'intérieur vers l'extérieur. Derrière le noyau, dans la direction opposée au soleil, on voyait un espace sombre qui avait la forme d'une parabole très-allongée touchant le noyau par son sommet."

Madras. Powell. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 64.)

"Nucleus brighter than ε Boötis and α Coronæ Borealis, but not so bright as Arcturus. . . . . .

"About the nucleus a cuspidated body of light visible, with a semicircular edge towards the sun. The following edge of the envelope clear and marked; the preceding faint and indistinct."

Kremsmünster. Reslhuber. (*Astron. Nachrichten*, 1169, p. 262.)

"Die Enveloppes entfernen sich allmälig vom Kerne, wie concentrische Wellenringe von ihren Entstehungs-Punkte. Der Kern und die Enveloppes sind durch abwechselnd hellere und dunklere Strahlen mit einander verbunden. Der Kern steht heute wieder frei da, er scheint kleiner, mit sehr intensivem Lichte."

Vienna. Schmidt. (*Astron. Nachrichten*, 1334, p. 220.) (For the notation see Oct. 4.)

"Für Oct. 3 fand ich:

t	r	w	n
$6^h\ 10^m$	$30''.8$	$\pm\ 0''.3$	10
7 56	38.0	0.7	10

Daraus ergiebt sich $g = 271 \pm 38$ Toisen in der Secunde."

Vienna. Weiss. (*Annalen der k. k. Sternw. Wien*, F. III. IX. p. 179.)

"Am 3 October hatte sich der Kern des Cometen beträchtlich vergrössert, und war unbestimmter begrenzt. Auch schien die relative Helligkeit des Kernes zur Coma sich vermindert zu haben. Der dunkle Raum zwischen beiden Schweifästen war sehr gut sichtbar, und schien sich bis näher an den Kern hin zu erstrecken, als an den vorhergehenden Tagen; er war auf der Seite des helleren Astes geradlinig begrenzt, auf der anderen gebogen und zwar derart, dass die concave Seite gegen den dunklen Theil gewendet war."

1858. October 4. (Plates XXXVI. and XLIX. 53-60.)

The development of the new envelope, *D*, and of the dark spot, is the special object of interest. The closed surface of *D* and its peculiar form, continued also on the 5th, are to be noted.

Observatory of Harvard College. G. P. Bond.

"A new envelope, *D*, very bright, has been thrown off since the 2d. It is bounded by a dark space outside of it, beyond which is the former inner envelope, *C*, now for the first time completely separated from the nucleus by the above-mentioned dark space. There is a decided dark spot on the new envelope. (See Plate XXXVI.) The outline of *D* on the side towards the tail is not clearly defined on close examination. The following measurements were taken: —

Nucleus to c', vertex of *C*, ...	32″.0
Nucleus to d', vertex of new envelope *D*, ...	10″.9
Transverse diameter of *C*, in the direction $c\,c''$, ...	84″.1
Transverse diameter of *D*, in a direction perpendicular to the axis of the tail,	33″.2

"The greatest diameter of *D* did not pass through the nucleus, but considerably above it, the outline closing in again from the intersection towards the nucleus.

Angle of position of the dark spot in *D* from the nucleus, .	281° 35′
Distance of dark spot from the nucleus, ...	6″.3
Angle of position of the tangent to the outline of *C* at $c\,c''$, .	53° 35′
" " " " " " c, . .	13 35
" " the following edge of the dark stripe, .	35 5

"The nucleus to-night seems to be smaller and less bright than on the 2d, as though expended in forming the new envelope."

Berlin. Bruhns. (*Astron. Nachrichten*, 1205, p. 73.)

"Octbr. 4 war er [der Kern] entschieden elliptisch, der Positionswinkel der grossen Achse 27°.51 (die Mitte des Schweifes hatte den Positionswinkel 31°.68). Grosse Achse 6″.78, kleine Achse 4″.82."

(Ibid., p. 74.)

"Die Ausstrahlung (den inneren Sector) habe ich an diesen Tagen auch gemessen und einmal auch den äussern Sector, ich finde für die Entfernung des äussern Randes des innern Sectors vom Mittelpunkt des Kerns in der Richtung des Schweifes: $19^h.6$ Sternzt. = 15″.81. . . . . .

"Oct. 4. Der äussere Rand des äussern Sectors war vom Mittelpunkt des Kerns entfernt $19^h.6$ Sternzt. = 39″.88.

"Der Positionswinkel der Mitte des innern Sectors fand sich: $19^h.7$ Sternzt. = 200°.58. . . . . .

"Auch ward die Achse des Schweifes oder die Mitte des schwarzen Streifens eingestellt und zwar so, dass der Faden die Mitte des Kerns und diese Mitte des Schweifes durchschnitt; ich finde den Positionswinkel $19^h.7$ Sternzt. = 31°.68.

[illegible] G. P. Bond.

"A new envelope, D, [illegible] has been thrown off since the 2d. It is bounded [illegible] which is the former inner envelope, C, [illegible] from the nucleus by the [illegible]. There is a decided dark spot on the new envelope. [illegible] The [illegible] of D on the side towards the tail is not clearly [illegible]. The following measurements were taken:—

[illegible] of C,	32″.0
[illegible] width of new envelope D,	10″.9
[illegible] diameter of C in the direction [illegible],	84″.1
[illegible] diameter of D in a direction perpendicular to the axis of the tail,	33″.2

"The greatest diameter of D did not pass through the nucleus, but considerably above it; [illegible] towards the [illegible].

Angle of position of the dark spot [illegible] from the nucleus,	281° 35′
Distance of dark spot from the nucleus,	6″.3
Angle of position of the [illegible] at [illegible],	53° 35′
" " " " [illegible],	13 35
" " " the following edge of the dark stripe,	35 5

"The nucleus to-night seems to be smaller and less bright than on the 2d, as [illegible] the new envelope."

[illegible] 1859, p. 73.)

[illegible] entschieden elliptisch, der Positionswinkel der [illegible] Mitte des Schweifes hatte den Positionswinkel 31°.68). [illegible]

[illegible] habe ich an diesen Tagen auch gemessen [illegible] für die Entfernung des [illegible] des Kerns in der Richtung der [illegible] 19h.7 Sternzt. = [illegible]

[illegible] war vom Mittelpunkt des Kerns entfernt [illegible]

"Der Positionswinkel der Mitte des innern Sectors fand sich: 19h.7 Sternzt. = [illegible]

"Auch [illegible] die Axe des Schweifes oder die Mitte des schwarzen Streifens [illegible] die Mitte des Kerns und diese Mitte des Schweifes [illegible] der Positionswinkel 19h.7 Sternzt. = 31°.68.

COMET OF DONATI 1858.

OCTOBER 4TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE. PLATE XXXVI

G P Bond Del. J. W. Watts Sc.

COMET OF DONATI 1858.

OCTOBER 5TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE. PLATE XXXVII

Printed by Chas. D. Andrews

"Am 4ten Oct., nachdem es hier am 2ten und 3ten trübe gewesen, bemerkte ich links einen grossen dunklen Flecken, der sich am 7ten durch eine Lichtlinie in 2 Theilen getheilt hatte, am 15ten sah ich nur, dass der Flecken sich mehr ausgebreitet hatte, konnte aber Details nicht mehr erkennen und ebenso war es Oct. 17 und 19.

"So gut es ging, habe ich die Mitte des Fleckens vom Kern durch den Faden des Positionskreises halbirt, und folgende Positionswinkel erhalten: 19^h.7 Sternzt. = 273°.95."

Greenwich. Christy. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 13.)

"The night unfavorable, and the comet was seen for a few minutes only. The outer annulus of light was narrower and less brilliant; the inner disk was evidently broader than on previous evenings; the spot on its surface was distinctly seen in the same position as before."

Florence. Donati. (*Bulletin Obs. Imp. de Paris.*)

"Le 4 et le 5 octobre, l'auréole qu'on avait vu paraître le 2, augmenta successivement de diamètre, et l'on vit une petite tache obscure paraître sur la partie nord (image directe). Une autre auréole commença à se détacher du noyau . . . . . M. le Prof. *Amici*, qui poursuivait les observations de la Comète à la campagne, vit aussi le 4 cette même tache, qui se deplaça le 6 et se porta vers la partie antérieure de l'auréole. Il lui sembla alors que la tache devenait le point de départ d'une faible ligne sombre qui s'étendit circulairement tout autour du noyau et dédoubla la première auréole."

Breslau. Galle. (*Astron. Nachrichten*, 1179, pp. 39, 40.)

"Die dunkle Trennungslinie zwischen den beiden Zweigen war im Cometensucher bis etwa 2° Entfernung vom Kopfe erkennbar. Dieselbe erschien, besonders im 4½ ff. Fraunh. bei 72 mal Vergr., etwas breiter als gestern; der linke Zweig, der dunkle Streifen und der rechte Zweig verhielten sich in der Breite = 3 : 2 : 2. Der Kopf bestand aus mehreren über einander liegenden, allmälig schwächeren, jedoch mit einiger Bestimmtheit sich abstufenden Hüllen, welche den hellsten Punkt nach oben hin (im Fernrohr) umgaben. Den hellsten Punkt (Kern) umgab zunächst ein fächerförmiger Schein, welcher gestern etwa auf 180°, heute jedoch noch weiter ausgebreitet war und auch mit einer Mondsichel verglichen werden konnte, welche auf dem Kern ruhte. Nach unten (im F.) war der Kern scharf abgeschnitten, auch waren die unteren Grenzen der Sichel mehr geradlinig als gebogen. Um diese matte Sichel legte sich dann eine dünnere Coma, deren Fortsetzung nach unten in Verbindung mit der Fortsetzung der Sichel die beiden Aeste des Schweifes bildete. Endlich war um die Coma herum ein noch viel

schwächerer Nebel erkennbar, der den Kopf unsymmetrisch umgab, so dass rechts (im Fernr.) dieser Nebel viel breiter als links war, wo derselbe sehr bald mit der verwaschenen Seite des Schweifes sich vermischte. Rechts gieng derselbe ebenfalls nur bis $\frac{1}{2}°$ herunter und die Grenze desselben fiel dann rasch mit der scharfbegrenzten Seite des Schweifes zusammen. Dieser seitlich um den Kopf ausgebreitete feine Nebel war hiernach bei der Bewegung des Cometen vorangehend, und hatte eine Breite (rechts) gleich der Breite der übrigen (symmetrischen) Hüllen zusammen genommen. Um 7^h 25^m befand sich gerade über dem Kopfe ein Stern 9. Grösse, dem sich dieser Nebel bis auf $\frac{3}{4}$ der Entfernung des Sternes vom Kern näherte. Bei Einsetzung einer stärkeren Vergrösserung, wurden alle Grenzlinien verwaschener und auch der helle Punct des Kerns bekam ein mehr nebelförmiges Ansehen."

Markree. Graham. (*Obs. of Donati's Comet*, 1858, *Markree*, p. 10.)

"There is a marked change in the thicker and brighter shell; it now envelopes the nucleus to the extent of at least 240°. The cusps have become blunted off, and are badly defined. The tail still appears to be of the same texture as, and merely a continuation and expansion of, the external envelope. The portion of the sky between the two streams of the tail forms, as nearly as the eye can judge, a parabola, similar to the outline of the exterior envelope, and whose vertex touches the nucleus. The thicker and brighter envelope preserves its sharp outline on the S. side through about 180°; the concave part, forming the apex of the parabola, is also well defined. I did not remark any trace of a transparent shell between the nucleus and the brighter one surrounding it; but I was suddenly arrested by clouds, and had not time to make a close scrutiny."

Liverpool. Hartnup. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 56.)

"The length of this shadow . . . . . was 21′, but the contrast between it and the dark band in the centre of the tail was much less striking than it was on the 30th September. . . . . .

"Diameter of nucleus,	20″
Diameter of first envelope,	1′ 40
Distance from centre of nucleus to front of coma,	1 32
Diameter of coma at right angles to tail, measured through centre of nucleus,	4 28
Length of tail measured along the curve on the convex side,	34° 20
Distance from nucleus to end of tail in a straight line,	31 30
Greatest diameter of the tail,	6 0"

Vienna. Hornstein or Weiss. (*Annalen der k. k. Sternw. Wien*, F. III. IX. p. 179.)

"Am 4 October hatte sich der erste, in fortwährendem Wachsen begriffene Fächer schon auf ungefähr das 3fache seiner Dimensionen vom 30 September vergrössert; seine Axe oder Mittellinie fiel mit der Schweifaxe nahe zusammen; die Helligkeit war an der Peripherie etwas grösser, als in der übrigen, dem Kerne näher liegenden Flächenausdehnung. Der dunkle, von der Sonne abgewendete Ausschnitt dieses Fächers war nicht mehr so scharf begrenzt wie an den vorhergehenden Tagen, und die Spitzen schienen allmälig durch alle Helligkeitsstufen in den Schweif überzugehen. Ferner hatte sich eine zweite, der früheren, fächerartigen Ausströmung sehr ähnliche gebildet. Dieser zweite Fächer lag dem ersten nahe concentrisch, seine Axe etwas nach rechts von der Axe des Schweifes. Er war durchaus scharf begrenzt, auch im dunklen Ausschnitt, dessen Grenzen zugleich das Ende des zwischen beiden Aesten des Schweifes befindlichen dunklen Raumes gegen den Kern zu bilden. Die relative Helligkeit des Kernes hatte sich noch vermindert, die Grösse desselben schien aber etwas beträchtlicher; zugleich war der Kern nicht rund, sondern zeigte eine solche Form, als wolle sich die Fächerbildung fortsetzen."

Munich. Lamont. (*Jahresbericht der k. St. bei München*, p. 18.)

"Am 4 Oct. sah ich den Kometen in der Gestalt Fig. . . . (Plate XLIX. 56); er bot im Ganzen dasselbe Ansehen dar wie am 3, so dass noch dasselbe Gerippe (Plate XLIX. 49) zur Erklärung dienen kann. Der äusserste Kopf war nur mit grösster Mühe sichtbar; dagegen die abfliessende Dunstmasse hinter dem Kopfe, d. h. von *A B* anfangend sehr deutlich, so dass es das Ansehen hatte, als wenn unmittelbar hinter dem Kopfe eine Erweiterung der Figur stattfände. Im innersten Kopfe blieb noch der schwarze Fleck fast eben so wie gestern: sonst aber waren mehrere Aenderungen eingetreten. Die Lichtmasse bei *d* hatte sich vermindert, ebenso die Lichtmasse bei *g;* und wenn man eine Vergleichung mit dem vorhergehenden Tage anstellte, so schien es, als seien von der Figur des vorigen Tages die Spitzen beiderseits abgeschnitten worden."

Bradstones. Lassell. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 79.)

"The change of aspect was marvellous. The black spot is an unexpected and surprising phenomenon. Unfortunately, the sky shortly clouded, only affording time for the following measures to be rather hastily taken:—

Diameter of nucleus,	. .	6″.68
" " 1st envelope,	.	36″.07
" " 2d envelope,	. .	81″.37

"The comet was generally not so well defined as yesterday."

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, p. 314.)

"October 3 war es trübe, October 4 ausgezeichnet klar. 5^h 51^m sah ich den Cometen in ganz heller Dämmerung. Nur der Kern und der Ausströmungs-Sector waren sichtbar. Der letztere hatte einen Umfang von etwa 180°, einen Radius von reichlich 15″; er hatte also seit Octb. 2 an Ausdehnung zugenommen. 15 Minuten später war schon die den Sector umgebende parabolisch geformte Zone sichtbar; ihr Scheitelradius betrug etwa 40″. Auf der linken Seite des Sectors etwa im Positionswinkel 280°, war ein feiner heller Strahl sichtbar, der sich abwärtsbiegend dem linken nachfolgenden Schweifaste zuneigte. Eine zweite, mehr fächerartige Ausstrahlung zeigte sich unter dem Pos.-Winkel 210° und war mit einer erheblichen Biegung nach links über den Rand der parabolischen Zone, auf der sie deutlich sich abhob, zu verfolgen. 10 Minuten später, als schon ein Theil des Schweifes sichtbar wurde, sah ich die fächerartige Ausströmung schwerer, vielleicht weil sie sich von der heller werdenden parabolischen Zone nicht so leicht unterscheiden liess. Die andere Ausstrahlung an der linken Seite war dagegen deutlich und weit bis in den Schweif zu verfolgen. Der linke Schweifast war in der Dämmerung erheblich heller als der rechte (vorangehende).

"Nach eingetretener Dunkelheit sah ich 7^h 10^m den Cometen mit den stärksten Vergrösserungen des 4 füss. Fraunhofer und fand die Figur des Ausströmungs-Sectors etwas anders als ich sie vorhin in heller Dämmerung gesehen hatte. Der Sector hatte einen Umfang von etwa 240°, seine Figur war mehr parabolisch; dabei seine Helligkeit an der rechten Seite stärker als links, wo die sonst scharfe Grenze durchaus unbestimmt und verwaschen war. Die früher bemerkte Ausstrahlung auf dieser Seite war noch deutlich sichtbar und wie mir schien, war sie breiter geworden als vorhin, vielleicht eine Folge der inzwischen eingetretenen Dunkelheit.

"Die den Sector umgebende Zone hatte auf der Sonnenseite einen hell hervortretenden Rand, der mir an frühern Abenden nicht aufgefallen ist. Die beiden Aeste des Schweifes, die sich Octbr. 1 und 2 noch scharf von dem sie umgebenden Nebel abhoben, waren heute durchaus verwaschen; die dunkle Zone zwischen ihnen schlecht begrenzt und weniger dunkel als früher. Die Erscheinung blieb so bis zum Untergang.

"Die Messungen der Richtungslinien ergaben:

6^h 22^m Pos.-Winkel des Sectors = 190°.70

" " Schweifes = 31°.20."

MADRAS. POWELL. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 64.)

"Nucleus nearly as bright as Arcturus, but very ragged; the cuspidated appear-

ance evident; the outline of envelope indistinct even on the upper or following side, showing in this respect a decided change since last night. A dark axial space visible down the envelope for the first time."

KREMSMÜNSTER. RESLHUBER. (*Astron. Nachrichten*, 1169, p. 262.)

"Himmel sehr rein. Eine neue Ausströmung aus dem Kerne macht sich bemerkbar."

VIENNA. SCHMIDT. (*Astron. Nachrichten*, 1334, pp. 219, 220.)

"Es zeigten sich 2 helle Halbkreise um den Kern, beide an der Seite gegen den Schweif offen. Den Halbmesser des äussern nenne ich *r′*, den des innern *r*. Die Zeiten *t* sind mittlere von Wien. *w* ist der wahrscheinliche Fehler des Mittels aus *n* Beobachtungen; alles in abgekürzten Zahlen.

t		*r′*	*w*	*n*
5^h 59^m.5	=	32″.2	± 0″.5	10
6 19.0		35.6	0.5	10
6 58.0		37.1	0.4	10
7 20.0		37.9	0.3	10
7 41.0		39.7	0.3	10

t		*r*	*w*	*n*
5^h 36^m.5	=	5″.4	± 0″.1	14
5 57.0		8.8	0.2	10
6 2.0		9.4	0.1	10
6 23.0		10.6	0.1	10
6 31.0		11.7	0.1	10
6 56.5		13.2	0.2	10
7 18.0		13.8	0.2	11
7 39.0		16.4	0.2	10
7 56.5		16.6	0.2	10
8 10.0		18.4	0.2	10
8 19.0		19.8	0.4	10

"Betrachten wir nur den innern Halo, so zeigt sich, dass sich die Werthe *r* durch eine gerade Linie construiren lassen, und dass die Zunahme der Zeit nahe proportional vor sich ging. Werden sie auf die Entfernung Eins reducirt, so findet man, dass *r* sich in 2^h 42^m.5 von 358 bis 1179 Meilen vergrössert habe (1 Grad = 15 Meilen); und da ich es für ausgemacht halte, dass diese Sectoren oder Fächer nur die Projectionen von Kugelschaalen waren, concentrisch vom Kern aufsteigend und sich ausdehnend, und deren grösste Helligkeit sich an den Rändern

zeigen musste, so kann ich aus diesen Angaben die Geschwindigkeit ableiten, mit welcher der Kern seine Materie ausströmte. Diese finde ich:

$$g = 321 \text{ Toisen} = 1926 \text{ par. Fuss in einer Secunde.}$$

"Aehnliche Werthe habe ich zwischen Oct. 1 und 18 aus allen (etwa 1700) Messungen berechnen können."

Dessau. Schwabe. (*Astron. Nachrichten*, 1165, p. 207.)

"Bei sehr reiner Luft sah ich mit 96 u. 144 m. V. einen doppelten Fächer, der nach der dem Schweife zugekehrten Seite offen war. Mit der 30 m. V. bildete dieser doppelte Fächer den scheinbar grössern scheibenförmigen Kern.

"Der kleinere innere Fächer hatte mehr Licht als der äussere und beide waren durch einen schmalen dunkeln Zwischenraum getrennt, der auf der (im a. F.) rechten Seite etwas breiter und deutlicher war. Der helle Kernpunkt verschwand erst mit 288 m. V. gänzlich. Die erwähnte schattenartige Stelle, die sich zwischen der Oeffnung des Fächers befand, zeigte sich fast schwarz und viel dunkler als der noch von der Dämmerung erhellte Himmel."

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 14.)

"Quello che ieri era 'una linea oscura continuata parallelamente all' orlo dell' aureola, questa sera trovasi ridotta a un semplice foro. L' aureola o piccolo ventaglio esterno (nimbo) è alquanto schiacciato dalla parte superiore e forma una curva ellissoidale dalla parte est apparente. L' ombra del nucleo è decisamente nera, ma molto corta. Angolo di posizione dell' asse della coda 28° 22′. La figura di questa sera mostra una deformazione troppo notabile per passare inosservata.' I due raggi o appendici sono molto ricurvi benchè corti: essi richiamano alla mente quelli già osservati da Messier nel 1769. V. *Arago* loco citato."

Tretire. Webb. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 22.)

"The whole circumference of the envelope, or photosphere, as it might in this case be termed, appeared entirely filled up with light, excepting where the central darkness cut out a large gap in it. . . . . .

"It [the dark hollow] was traced for a length of 2° or 2½° before it was merged in the general brightness."

1858. October 5. (Plates XXXVII. and XLIX. 61 – 70.)

A bright spot, or secondary nucleus, as it was called by some, was recognized on the 5th, within the envelope *D*, and in the neighborhood of the dark spot or opening first seen on the 3d.

Greenwich. Airy. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 13.)

"The nucleus was much as before; but I am not certain whether the small

surrounding circle was visible. I fancied that I saw it much contracted. The large surrounding circle was very plain, and was distinctly separated from the parabolic envelope; the black shadow more obtuse; the tail about the same length. The general light of the Comet, I think, was diminished. Its head now is not so bright as *Arcturus;* whereas, in the last two views, I thought it much brighter than *Arcturus*."

Copenhagen. D'Arrest. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 217.)

"Efter nogle mœrke Aftener viste det sig den 5 October tydeligt, at den ovenfor omtalte mœrke Stribe den 1 October ikke havde været Andet, end Begyndelsen af Halens Adskillelse. i to aldeles afsondrede Grene. Arktur stod i Aften lige i Halen, ikkun henved 20 Bueminuter Nord for Kjærnen. Saalænge Stjernen stod i det mœrke Mellemrum mellem begge Halens Grene, viiste der sig slet ingen Forandring i dens sædvanlige Glands og synlige Stœrrelse, og siden efter, da samme Stjerne noget senere ud paa Aftenen kom til at staæ indenfor den venstre (vestlige) Grene, syntes den ikke at tabe mere, end en saa lys Baggrund nœdvendigen altid vil foraarsage. Fig. . . . (Plate XLIX. 70.)

"Den sorte Plet, som Hr. *W. Lassel* og Rev. *W. R. Dawes* den 4 og 5 October iagttoge i det andet Hylster,* har jeg, muligen paa Grund af Veiret eller fordi de brugte Forstœrrelser dertil vare altfor svage, ikke seet Noget til."

Observatory of Harvard College. G. P. Bond.

"Saw the Comet at 4^h P. M. in full sunlight; it was, however, extremely faint. The diameter of the whole object was $20''$ or $30''$, but only the nucleus was evident, the rest by fitful impressions until sunset. The diameter of the brightest part — not very well defined — $2''$ or $3''$.

"At 5^h 51^m M. T., 16^m after sunset, a sketch was made, showing the new envelope in considerable detail, with the dark spot and the darkness in the rear of the nucleus, marked 'very dark.'

"At 5^h 56^m M. T., the second envelope, *C*, begins to be seen. The Comet is already visible to the naked eye, 21^m after sunset. The diameter of the nucleus is $1''.5$. It is certainly less than $2''$, in strong twilight, and well defined. Examined with high powers up to 1500, it showed no certain phase in the bright kernel. The form of the envelope *D* is very peculiar, like a crown or turban, the longest diameter being considerably above the nucleus towards the sun. A little wisp or jet streams off to the right from its vertex, and others from the

* "Den 'lysende Sektor' i nærværende Beskrivelse er nemlig uden Tvivl identisk med Hr. *Lassel's* 'second envelope.' Cfr. *Monthly Notices of the Roy. Astr. Soc.*, Vol. XIX. Nr. 3, pag. 79 og 89."

lower right-hand side, like rain beginning to fall from a distant cloud, or like the ragged edges of a cloud-cap resting upon the summit of a mountain.

Angle of position of the dark spot in *D*, from a diagram made at 5^h 51^m,	276° 35′
Distance of spot from nucleus by this diagram,	10″
Angle of position of the dark spot in *D*, from a diagram drawn later in the evening,	259° 45′
Distance of spot from nucleus by this diagram,	10″
Transverse diameter of *D* (above the nucleus),	33″.2
Transverse diameter of *C*, *c* to *c″*,	99″.9
Transverse diameter of ill-defined but pretty sudden limit of strong light,	150″.1
Nucleus to *d′*, vertex of *D*,	15″.6
Nucleus to *c′*, vertex of *C*,	35″.4
Nucleus to *b′*? ill-defined but pretty sudden limit of strong light,	52″.5
Angle of position of dark stripe,	38° 15′"

Cambridge, Eng. Breen. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 17.)

"'A hole in the fantail adjoining the nucleus.' A sketch represented a dark patch on the left side of the nucleus, and within it, near the nucleus, a bright spot; also a less conspicuous patch above the nucleus."

Berlin. Bruhns. (*Astron. Nachrichten*, 1205, p. 74.)

"Positionswinkel der Mitte des innern Sectors fand sich: $19^h.6$ Sternzt. = 211°.15 ..... Mitte des Fleckens vom Kern. ..... Positionswinkel $19^h.6$ Sternzt. = 270°.89."

Ann Arbor. Brünnow. (*Mss.*)

"Oct. 5 was clear. The fan-shaped jet formed now another envelope, which, however, was not separated by an entirely dark space from the nucleus, the interval being filled with some light matter. Outside of this was a second envelope, separated from the former by a darker space, and outside of this still another faint one. The envelopes, like the tail, were brighter on the preceding side.

"The phenomenon which attracted my attention the most was a condensation like another small nucleus between the nucleus and the first envelope. I measured the position of it with respect to the main nucleus, and found

Angle of Pos.	Dist.
304° 17′	7″.71
306 1	8.61
305 34	9.43"
305 55	

CAMBRIDGE, ENG. CHALLIS. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 18.)

"'There were two dark openings in the space included by the external arch, the larger on the left side of the nucleus, and the smaller above it. Also between the larger and the nucleus was a bright point, but not so bright as the nucleus.' A sketch (Plate XLIX. 66) exhibited these openings as faint patches, irregular in form and distribution of light, and the bright point as a small spot of light near the nucleus.

(Ibid., p. 19.)

"This evening I looked at the light of the tail with a Nichol's prism and a tourmaline, and found that not far from the nucleus there was some polarization."

GREENWICH. CHRISTY. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 13.)

"The diameter of the inner disk immediately surrounding the nucleus, which has been increasing for the last three days, is now about double its apparent size on Oct. 2. The spot on its surface appears to be developing itself in the form of a dark concentric ring, as it is considerably elongated, and a little to its right are slight traces of its continuation.

"The outer circle of light has entirely disappeared. This may, perhaps, be owing to the general faintness of the Comet, as compared with its brightness on the last few evenings. It has been continually diminishing both in lustre and width. The shape of the envelope appears rather sharper than a parabola. *Arcturus* was in the middle of the tail at 7^h 15^m M. T.; its distance from the nucleus being as nearly as possible equal to twice the width of the tail measured through the point bisecting that distance."

HADDENHAM. DAWES. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 89.)

"At 6^h 30^m G. M. T. *Arcturus* is just within the eastern boundary of the comet's tail, and about 20′ north of the nucleus.

"The edge of the outer sector is much more indistinct than it was some days ago, and so is also the edge of the eastern side of the tail.

"The inner sector is astonishingly enlarged since Oct. 2. There is in it an irregular *dark* spot on the western side of the nucleus; and a little to the north of that dark spot, and nearer to the nucleus, there is a *bright* spot softly defined and less bright than the nucleus.

"At 7^h 11^m *Arcturus* is judged to be in the middle of the tail.

"At 7^h 15^m *Arcturus* is in the dark channel.

"At 7^h 56^m *Arcturus* is just out of the tail on the western side."

(Ibid., p. 90.)

"The middle radius of the *interior* sector makes an angle of about 176° with the direction of the dark channel. The *exterior* sector is not sufficiently well defined

at its extremities to admit of accurate estimation of the middle point of its arc; but its direction does not differ much from that of the interior sector."

Christiania. Fearnley. (*Astron. Nachrichten*, 1242, p. 274.)

"Am 5ten Oct. war der Flecken merklich grösser, aber etwas matter, am 6ten viel matter und in zwei unregelmässig begrenzte getheilt."

(Ibid., p. 275.)

"Ich fand am 4 zölligen Fernrohr des Aequatorials den Durchmesser des Kerns Oct. 5 gleich $1''.7$."

Breslau. Galle. (*Astron. Nachrichten*, 1179, p. 40.)

"Das Ansehen des Cometen war ähnlich wie am gestrigen Tage; nur war der den Kern umgebende fächerförmige Schein nach unten noch weniger geoffnet, so dass an dem vollen Kreise nur etwa 120° fehlten. Es folgten demnächst noch zwei schwächere Hüllen und um diese am Kopfe derselbe sehr feine Nebel wie gestern, rechts (im F.) viel ausgedehnter als links, jedoch nach unten rasch schmäler werdend und in der scharf begrenzten Seite des Schweifes sich verlierend. In der Gegend des Endes dieser unsymmetrischen Ausbiegung befand sich um 6^h 25^m Arctur."

Markree. Graham. (*Obs. of Donati's Comet* 1858, *Markree*, p. 20.)

"The appearance of the head is, on the whole, pretty nearly the same as last night; but, there being more time for observation, we were able to examine it more in detail. My impression was, that though the interior envelope was curved to nearly the same extent, viz. 240°, it was brightest to the S. of a right line crossing the nucleus at its N. side; in fact, that the brightest part was semicircular, or rather semi-elliptical, the major axis being the line alluded to, perpendicular to the axis of the tail. The preceding or W. cusp was better marked than the other. The most remarkable peculiarity of this night is a dark elliptical spot, about the size of the nucleus, upon the exterior envelope, on the S. preceding side, its length perpendicular to a radius vector through its middle. Mr. Cooper, as well as I, perceived this spot distinctly, and in different positions in the field of view, and so did Mr. C. Robertson.

"The exterior envelope of the coma was about the breadth of the interior, and hung round it in two streams of light, widening as they receded from the nucleus, giving the impression of lank and very fine hair. Mr. R. fancied he saw another very faint envelope still farther from the nucleus; but I had no such impression, though he directed my attention to it before the clouds interrupted us. The drawing on black paper with white chalk was made from memory, as the clouds came up too soon; but it seems to me a fair representation."

. . . . . Grove. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 29.)

"When [*Arcturus*] had entered well within the margin of the tail, a dark notch was formed, cutting out a portion of the tail round the star; and as the star got farther in, this became a dark aureola surrounding the star, and in diameter equal to about one tenth of the line of transit. This continued until the star reached the middle; at this part there is a broad dark line which extends from the nucleus to a distance considerably above the point where the star crossed. When *Arcturus* arrived here, this dark space was perfect up to the star, but on the other side the white light of the tail appeared to come quite up to the star; in short, as the bright part of the tail had been darkened in the vicinity of the star, the dark part was brightened, at least so much of it as was on the side farthest from the nucleus.

"I saw the notch again on the opposite side previous to emersion, and then lost it by clouds. The effects I have described are, doubtless, optical, and the notch and aureola evidently due to the bright light of this star; the effect on the dark central part is not so easy to explain."

. . . . . Hodgson. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 86.)

"Daylight, 11 A. M. *Arcturus* bright as a point; but the comet invisible, though the clock carried the telescope ($6\frac{1}{3}$ inches aperture; 7 feet 6 inches in focal length). Power used, low comet eye-piece, magnifying 25 times."

Vienna. Hornstein or Weiss. (*Annalen der k. k. Sternw. Wien*, F. III. IX. p. 180.)

"Am 5 October Mittags wurde Arcturus aufgesucht, und konnte ungeachtet bedeutenden Nebels sehr gut beobachtet werden, während vom Cometen keine Spur zu sehen war. Um 5^h 14^m M. Z. war er aber im Refractor schon gut sichtbar, Arcturus erschien gleichzeitig im Fernrohre vielmal glänzender.

"Bei vorgerückter Dämmerung (6^h 36^m) schien dem freien Auge der Kern sammt der ihn zunächst umgebenden Nebelhülle nur wenig schwächer als Arcturus."

Neuchatel. Jeanjaquet. (*Souvenirs de la Comète de* 1858, p. 12.)

"Nous voici au 5 octobre, jour annoncé par les astronomes comme celui où la comète ne doit plus se trouver, après le coucher du soleil, qu'à un tiers de degré d'Arcturus. Il est 6 heures, des nuages défilent longuement pour mon impatience, dans cette partie du ciel où Arcturus réside, ils se dissipent enfin, je vois une étoile jaune et un peu au-dessous à sa droite une petite aigrette blanche. Ces deux couleurs me frappent, on dirait que l'étoile est en or et l'aigrette en argent."

Dorpat. Mädler. (*Beob. Kaiserl. Sternw. Dorpat*, XV. p. 45.)

"Die Lichtkrone des Kopfes deutlich gesehen, aber nur auf einige Secunden, sie schien im Allgemeinen der vom 30 September gleich zu sein. . . . .

"Die Vergleichung mit dem rothen Arctur zeigte deutlich, dass die Farbe des Cometenkopfs ein mattes Gelb war. . . . . .

"Arctur trat noch vor dem Untergange in den Schweif und zwar in dessen lichtesten Theil, doch ohne weder an Glanz noch an Farbe zu verlieren."

Altona. Pape. (*Astron. Nachrichten*, 1172, p. 315.)

"Der folgende Abend des 5 Octbr. zeigte, als es sich um 6^h aufhellte, eine ganz veränderte Erscheinung. Der Kern des Cometen war von einem doppelten Sector, einem doppelten Heiligenschein gleichsam umgeben, so dass nur auf der dem Schweif zugekehrten Seite ein Raum von etwa 100° – 120° frei blieb. Der innere Ausströmungs-Sector war bei weitem heller als der äussere, fast so hell als der Kern, jedoch an seiner rechten vorangehenden Seite verwaschen. So war der Anblick des Cometen bei 60 – 70 facher Vergrösserung. Die Anwendung stärkerer Vergrösserungen zeigte bald, dass die Begrenzung des äussern Sectors sehr verwaschen war, und bei Vergr. 216 war er nur mit Mühe von den beiden ihn begrenzenden Schweifästen zu unterscheiden, in die offenbar die ihn bildende Lichtmaterie überströmte.

"Den Radius des innern Sectors schätzte ich zu 25″, den des äussern zu etwa 40″ – 45″. Die beiden Schweifäste waren durchaus nicht mehr scharf begrenzt, die dunkle Zone zwischen beiden heller als früher und die Neigung beider Aeste gegen einander war seit Octbr. 2 entschieden stärker geworden. Die Ausdehnung des Nebels auf der Sonnenseite mochte etwa 3′ – 4′ betragen. Ich erhielt folgende Pos.-Winkel:

$$\begin{array}{lll} 6^h\ 25^m\ \text{Sector} & = & 233^\circ.35 \\ \quad\quad\ \ \text{Schweif} & = & 36^\circ.65. \end{array}$$

Herr Prof. *Peters* schätzt die Richtung des Sectors um dieselbe Zeit = 246°."

Observatory of Hamilton College, Clinton, N. Y. C. H. F. Peters. (*Mss.*)

"Both the coronas are very distinct. The outline of the tail much better defined on the east side. The tail seems to be hollow; it has a darker space within, the limits of which are badly defined, better to the right, less distinctly to the left. This hollow seems by itself to form a kind of paraboloid, its apex coinciding with the nucleus, and its parameter being about equal to the diameter of the inner corona. The light in it decreases from the edges towards the middle, at first pretty abruptly, and then very slowly; and upon it is projected excentrically the black shadow of the nucleus, with its neat, sharp, rectilinear edges."

Geneva. Plantamour. (*Note sur la Comète de Donati*, p. 8.)

"Le 5 octobre, à 6 heures 50 minutes du soir, l'espace obscur derrière le noyau s'est élargi. L'enveloppe lumineuse intérieure s'est arrondie sous forme de disque,

d'environ 1 minute de diamètre, assez nettement terminé avec un grossissement de 75 fois. Cette enveloppe n'est pas également brillante dans toute son étendue, elle présente des bandes concentriques alternativement plus brillantes et plus obscures, la partie opposée au soleil étant masquée par l'espace obscur dont j'ai parlé. L'enveloppe extérieure a la forme parabolique."

Oxford, Eng. Pogson. (*Cycle of Celestial Objects, continued at the Hartwell Observatory to* 1859, p. 257.)

"One observation of light-intensity, however, we did obtain when *Arcturus* was so near as to be in the same field of view with the comet, and if you will make any record of it, I can assure you that it is a most trustworthy comparison, carefully made, by an excellent method.

"The comet, seen through the undiminished half of the heliometer object-glass, appeared of equal intensity with *Arcturus* seen through the other half diminished to 0.95 inch. *Arcturus* was, therefore, 62.3 times as intense as the comet, or, adopting *Argelander's* ratio of 2.512, the difference of magnitude was 4.5."

Vienna. Schmidt. (*Mss.*) (For explanation of the notation, see Oct. 4.)

$5^h\ 36^m.5$	$r' =$	$11''.28$	10 Beob.
7 21.0		21.26	10 "
$6^h\ 4^m.0$	$r'' =$	$39''.68$	10 Beob.
7 14.0		45.61	10 "

Oxford, Eng. Slatter. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 24.)

"The nucleus to the naked eye not so bright as on the 1st, which was fully explained by the telescope. 7 P. M. Nucleus small and bright, and round; diameter 4″.8.

"Envelope very large and bright; the posterior edges greatly prolonged behind the nucleus, and opening out at an angle slightly differing from 90° by estimation. Parameter 59″.

"To the naked eye, *Arcturus*, through the tail, appeared, if anything, to scintillate more than usual; and in the telescope its light appeared white, instead of its usual golden color."

Poulkova. O. Struve. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 8, 9.)

"Den Durchmesser des Kerns schätzte ich heute zu 5″. Am Fächer und Halbbogen wurden folgende Schätzungen und Messungen erhalten.

$20^h\ 0^m$ — $20^h\ 15^m$.

1. Am Fächer.

Vorangehende Spitze, Richtung,	329°,	Abstand,	12″
Nachfolgende "	"	88°,	"	12″
Abstand auf dem Parallele des Kerns, vorangehend,			17″
" in der Richtung nach Süden,			14″.

2. Am Halbbogen.

Abstand auf dem Parallele des Kerns, vorangehend, $4^r.22 = 41''.0$
" " " " nachfolgend, $5^r.32 = 51''.8$
" in der Richtung nach Süden, $3^r.76 = 36''.6$.

"Der Halbbogen war erheblich breiter als früher, und nur durch einen, kaum 4″ breiten, etwas dunkleren Zwischenraum vom Fächer getrennt.

"Die südliche schwache Nebelhülle hatte heute eine Ausdehnung von wenigstens 10′, in der Richtung 185°. Der dunkle Zwischenraum zwischen den beiden Schweifhälften ist heute erheblich breiter als Sept. 30, aber an den Rändern mehr verwaschen und theilweise mit Nebelmaterie gefüllt. Er beginnt gleich beim Kerne und schliesst sich fast der ganzen Breite nach an die nördliche Begränzung des Fächers an. Seine mittlere Richtung wurde an der vorangehenden Seite zu 33°.0, an der nachfolgenden zu 38°.5 gemessen.

"Die Breite des Cometen betrug, in 5 Minuten Abstand vom Kern, ungefähr 6′, von welchen 1′.5 auf die vorangehende Schweifhälfte, 1′.5 auf den dunklen Zwischenraum und 3′.0 auf die nachfolgende Schweifhälfte kommen. . . . . .

"Anmerkung. Durch die Verbindung des Cometen mit Arcturus, war an diesem Abende die günstigste Zeit für die Beobachtung der Erscheinungen am Kopfe desselben, für diesen Zweck unbenutzt geblieben. Nach Beendigung jener Verbindung zeigten sich schon am Horizonte Wolken und es musste daher geeilt werden die vorstehenden Bestimmungen zu sammeln. Möglicherweise sind mir aus diesem Grunde einige Details entgangen. Um 20^h 20^m verschwand der Comet hinter dichten Wolken."

Tretire. Webb. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 23.)

"During the magnificent transit over *Arcturus* it was remarkable how distinctly and fully the light of the large object-glass brought out the tail, even close to the dazzling disk of that vivid star."

(Ibid., p. 22.)

"It was doubtful whether or not its outline [that of the envelope] was defined by a more luminous arc; but now its principal brightness was confined to about a hemisphere, not however symmetrically situated with respect to the general figure of the comet, but inclining a little backwards as though left behind in its movement, so that the faint sector which completed its form round to the central darkness on the antecedent side was considerably larger than the corresponding one in the subsequent direction; this was not very distinctly made out, but such was the prevailing expression."

POULKOVA. WINNECKE. (*Pulk. Beob. des Grossen Cometen* 1858, p. 21.)

"Der Kopf war für das blosse Auge fast so hell als der dicht daneben stehende Arctur; im Fernrohre der Kern ungemein viel schwächer."

(Ibid., p. 24.)

"20^h 0^m. Es heiterte sich auf eine halbe Stunde auf, jedoch nicht völlig, da der Comet häufig von Wolken bedeckt war. Der innere helle Sector hat seine Form beträchtlich verändert; er ist nicht mehr durch Bogen begränzt, die sich der Kreisform nähern, sondern in der auf die Axe des Schweifes senkrechten Richtung etwas eingedrückt, so dass die Begränzung Aehnlichkeit hat mit dem nicht geschlossenen Theile der Glockenlinie. Im Innern des Sectors war eine sehr merkwürdige dunklere Stelle, etwa unter dem Positionswinkel 270° vom Kerne ab, deren nähere Untersuchung die Kürze der Zeit verhinderte. Die Spitzen der Sectoren waren heute nicht so weit unterhalb des Kernes verlängert, als am 30 Sept.

"Der zweite Sector hat sich nicht so stark verändert, die Figur scheint dieselbe zu sein, nur ist der dunklere Ring unmittelbar am innern Sector schmäler geworden.

Es ergab sich	d	$= 13''.8$	2 Beob.
" "	d'	$= 31''.4$	1 Beob.

"Die äussere Umhüllung schien mir sich gar nicht verändert zu haben; der Abstand der Begränzung derselben in der Richtung der Aufblähung war $5'$."

(Ibid., p. 32.)

"20^h 12^m Sternz. $p = 38°.31$. 4 Beob. . . . .

"Der dunkle Raum in der Mitte des Schweifes war bedeutend breiter geworden; er schloss sich, wie immer, unmittelbar an den Kern an."

1858. October 6. (Plates XXXVIII. and XLIX. 71 - 75.)

The transfer of the remaining traces of the outer envelopes to the region below the nucleus will be noticed on the 6th, together with the more symmetrical disposition of the envelopes and of the light of the two branches of the tail. The dark opening in D continues in sight.

COPENHAGEN. D'ARREST. (*Oversigt kgl. danske Videnskabernes Selskabs*, 1858, p. 217.)

"Jeg saae Kometen, om end lavt, endnu temmelig godt den 6 Octbr. Dens Udseende paa denne Aften har jeg efter Evne gjengivet paa den anden medfølgende Tavle Fig. . . . (Plate XLIX. 74.) Omkring Kjærnen, men alligevel *indenfor* Halen endnu, havde der atter udsondret sig et nyt, concentrisk Hylster, saaledes at dengang i vor forholdsviis saa svage Kikkert ikke mindre end fire, tydeligt fra hinanden adskilte Hylstre samtidigt lod sig tilsyne."

Göttingen. Auwers. (*Astron. Nachrichten*, 1167, p. 235.)

"Durchmesser des Kerns = 2″.84."

Observatory of Harvard College. G. P. Bond.

The spot which made its appearance on the 3d upon the envelope *D* had increased to a dark opening, still maintaining nearly its original direction from the nucleus and its relative position in the envelope.

The latter was traversed by several bright jets, one of which was directed nearly towards the spot. There was a bright streak or spot in the region to the left of the nucleus, half-way between it and the outer edge of *D*.

"The dark arcs outside of the envelopes are well defined far below the nucleus, and the outermost one (outside of *B*?) can scarcely be seen excepting below."

According to the sketches, they were symmetrical on either side of the axis, with which the direction from the nucleus to the last traces makes an angle of about 53° on either side. "The outline of *B* is seen on both sides; that of *C* can be traced 37″.9 below the nucleus in the direction of the axis of the tail. Outside of the third dark interval surrounding *B* is an outer nebulosity on the background of the sky. Below the nucleus the asymptote of *C* is inclined by 10° with the axis of the tail. On the opposite side the asymptote is inclined by only 3°." The following measurements were taken:—

Transverse diameter of *D*, ...	38″.2

This diameter passes 8″ above the nucleus.

Transverse diameter of *C* in the direction *c c″*, ...	104.4
Nucleus to *d′*, the vertex of *D*, ...	17.8
Nucleus to *c′*, the vertex of *C*, ...	38.2
Angle of position of centre of axis of the tail, ...	40° 35′

Two sketches of the dark and bright spots in *D* were made, from which we have the following measurements:—

From (1) angle of position of dark spot,	224° 0′ + 40° 35′ =	264° 35′
From (2) " " "	221 30 + 40 35 =	262 5
From (1) " " bright spot,	257 0 + 40 35 =	297 35
From (2) " " "	252 0 + 40 35 =	292 35

From (1) distance of dark spot from nucleus, ...	12″.7
From (2) " " " "	11.8
From (1) " centre of bright streak from nucleus, .	7.1
From (2) " bright spot from nucleus, ...	6.8
Diameter of nucleus, ...	3.0

It is very small, with bright jets.

The sketches show more nebulosity streaming out from *D* into the tail on the right-hand side than on the left.

Cambridge, Eng. Breen. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 17.)

"The same appearance as on Oct. 5, but the dark part in the nucleus [?] was not so well or so largely seen, and the left side of the arch was not so well defined."

Berlin. Bruhns. (*Astron. Nachrichten*, 1205, p. 73.)

"Durchmesser des Kerns (der Kern war rund), $4''.53$."

(Ibid., p. 74.)

"Entfernung des äussern Randes des innern Sectors vom Mittelpunkt des Kerns in der Richtung des Schweifes: $19^h.5$ Sternzt. = $14''.91$.

Der Positionswinkel der Mitte des innern Sectors fand sich, $19^h.6$ Sternzt. = $216^\circ.78$

..... Mitte des Schweifes ..... Positionswinkel, 19.6 Sternzt. = 41.78

..... Mitte des Fleckens vom Kern ..... Positionswinkel, 19.6 Sternzt. = 254.85."

Paris. Chacornac. (*Bulletin Obs. Imp. de Paris.*)

"Le 6 8^{bre} quatre petits nuages lumineux étaient répandus sur la surface de la sixième enveloppe. L'éclat de cette enveloppe était à peu près réparti uniformément de part et d'autre de l'axe de la queue, et il en était de même le lendemain."

Cambridge, Eng. Challis. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 19.)

"'The cusp of the nucleus not so sharp to-night; the left-hand irregular patch seen, but the one above scarcely discernible. There was much cloud about.' A sketch (Plate XLIX. 72) exhibited the bright spot on the right-hand border of the irregular patch, and very near the nucleus."

Florence. Donati. (*Bulletin Obs. Imp. de Paris.*)

"Le 6 octobre, je vois toujours la tache sombre dont le centre est occupé par une tache claire assez semblable à un second noyau, ou du moins à une agglomération informe de matière autour de laquelle apparaissait une auréole demi-circulaire qui interrompait la première auréole du noyau principal.

"Je suis bien sûr d'avoir vu le développement progressif, ou accroissement de l'auréole que j'avais vue le 2 octobre se détacher du noyau central."

Breslau. Galle. (*Astron. Nachrichten*, 1179, p. 40.)

"Der den Kern umgebende kreisförmige Schein hatte nach unten (im F.) eine noch kleinere Oeffnung als gestern. Auch war dieser Schein nicht gleichförmig hell, sondern zeigte concentrisch mit der Peripherie eine Reihe Schattirungen. Auch gingen von dem Kern einige hellere Linien strahlenartig aus; der Kern lief nach unten in eine feine Spitze aus. Die sonstigen Umhüllungen des Kopfes wie gestern."

. . . . . . Hodgson. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 86.)

"Repeated the observation at 11 P. M. Covered my head with hood, and excluded all extraneous light from the eye, but could not see the Comet. *Arcturus* brilliant; and *Jupiter* to be seen near the western horizon."

Neuchatel. Jeanjaquet. (*Souvenirs de la Comète de* 1858, p. 15.)

"Son noyau petit, vif et de couleur rouge-jaune, repose, ainsi qu'il reposait hier, sur le centre concave d'un croissant dont les cornes tendent à se rejoindre pardessus lui: petite boule brillante fixée sur le centre de gravité d'une cycloïde. Si l'on me demande les proportions réciproques de ces deux objets, je dirai qu'il peut y avoir entre la grandeur du noyau et celle du croissant la différence qui s'observe entre la Lune en octant et Jupiter."

Dorpat. Mädler. (*Beob. Kaiserl. Sternw. Dorpat*, XV. p. 45.)

"Um 8 Uhr erfolgte, nach heftigem Regen, eine theilweise Aufheiterung.— Die Lichtkrone des Cometen Kopfes zeigte noch die 3 concentrischen Abtheilungen, aber die dunklere Mittelzone sehr schmal, überhaupt war nur der äussere Rand leidlich gut begrenzt. Diese Krone umfasste heut reichlich 270° des Umfangs, so dass nur ein dunkler Quadrant auf der Seite des Schweifs, aber von der Richtung desselben abweichend, hervortrat.

Richtung der Ausstrahlung,	$21^h\ 11^m$ . .	$213^\circ\ 19'$
Richtung des Schweifs (der dunklen Spalte),	21 14 . .	38 54
Halbmesser der gesammten Ausstrahlung,	21 33 . . .	26″.902."

Altona. Pape. (*Astron. Nachrichten*, 1172, p. 316.)

"$6^h\ 45^m$ ward der Comet zwischen Wolken sichtbar: Der gestern bei schwächern Vergrösserungen wahrgenommene äussere Sector war verschwunden. Der innere hatte an Durchmesser zugenommen, sein Umfang dagegen betrug nicht über 180°. Die Form schien mir parabolisch zu sein und zwar lag der Kern nicht im Brennpunct der Figur, sondern der rechten sehr verwaschenen Gränze näher. Den Radius des Sectors schätzte ich zu 30″, den der parabolischen Zone, die ihn umgab zu etwa 40″-45″. Die äussere Dunsthülle des Cometen war über 4′ vom Kern zu verfolgen, ihre Form war durchaus nicht regelmässig, sondern nach der vorangehenden Seite herausgebogen. Unmittelbar am Kern war eine innere sehr kleine, aber helle Ausströmung sichtbar; jedoch war das benutzte Fernrohr zu schwach, um diese Erscheinung deutlich zu zeigen.

"Die Messungen der Pos.-Winkel ergaben:—

$6^h\ 50^m$ Richtung des Sectors = 236°.40

" " Schweifes = 42°.40."

Observatory of Hamilton College, Clinton, N. Y. C. H. F. Peters. (*Mss.*)

"The evening very fine. *Two coronas* or envelopes, surrounded by the *coma*, which is united with and runs out into the parabolic veil of the tail. The coronas, on the contrary, are closed on all sides. On the rear, that is, on the side from the sun, they are bent inward (which makes them appear, especially the outer one, almost in the shape of a general's hat), adhering to the nucleus, or this latter showing as if half immersed. There is a great flaming or emanation of light from the nucleus towards the interior of the inner corona; — the flames do not pass into the outer one. The rear half of the nucleus shines with equally intense, but calm light, does not radiate flames, but has a sharp outline, whence immediately the shadow begins. On the whole, the nucleus gives the impression of being transversely oblong; however, there appears no boundary to it in front. Most remarkable are two *black spots* on the inner or brighter corona, one to the right and one to the left, and nearly at equal distances from nucleus and limb of corona. They are curved, about like eyebrows, and are seen now and then suddenly to wave or to change in shape (if that be not an optical illusion), but rather to retain their symmetrical curvature on the outer end nearly parallel to the limb, their other end narrowing to a fine line, which bends towards the nucleus. The spot to the left is more distinct, also somewhat wider. The *shadow of the nucleus* is beautifully clear, excentric (towards the right) in the hollow or the darker middle of the tail."

Geneva. Plantamour. (*Note sur la Comète de Donati*, p. 8.)

"Le 6 octobre, à 6 heures 30 minutes du soir, l'espace obscur derrière le noyau s'est encore élargi, et le noyau très-brillant, d'un diamètre de 12″ environ, est placé dans une échancrure de cet espace obscur. L'enveloppe intérieure a la même apparence que la veille, un disque dont le diamètre est 5 fois celui du noyau; l'enveloppe parabolique extérieure paraît plus rapprochée de la tête."

Kremsmünster. Reslhuber. (*Astron. Nachrichten*, 1169, p. 263.)

"Nahe dem Kerne im Bereiche der ersten Enveloppe bemerkt man auf der Westseite des Kernes vier kleine wolkige Verdichtungen der Nebelmasse."

Padua. Ronzoni. (*Comptes Rendus*, Vol. XLVIII. p. 236.)

"M. Ronzoni, professeur de physique à Padone, annonce que le 6 octobre, 1858, il a pu reconnaître très-nettement, à l'aide *d'une simple tourmaline*, la lumière polarisée de la Comète de Donati. Il cite une observation de M. Govi à Florence, publiée le 15 décembre, 1858, dans le *Nuovo Cimento* (Torino Pisa, p. 290), d'après laquelle l'objectif d'une lunette d'Amici aurait été doué accidentellement du pouvoir biréfringent; il en conclut que l'intervention d'une lunette astronomique dans

l'étude de la lumière de la comète de Donati peut compliquer le phénomène et jeter des doutes sur les résultats. L'observation qu'il a faite avec une simple tourmaline échappe à l'objection et lui semble, au contraire, mériter toute confiance, à cause de la simplicité du polariscope qu'il a employé. L'observation de M. Ronzoni a été publiée dans la *Rivista Euganea* du 14 octobre, 1858."

VIENNA. SCHMIDT. (*Mss.*) (For the notation, see Oct. 4.)

Nur 1 Sector,	$7^h\ 14^m.5$	$r' = 25''.75$	10 Beob.
	8 7.0	29.75	10 "

DESSAU. SCHWABE. (*Astron. Nachrichten*, 1165, p. 208.)

"Der doppelte Fächer war rechts (im astr. F.) lichtvoller als links, der dunkele Zwischenraum aber verschwunden."

1858. October 7. (Plate XLIX. 76-82.)

Numerous observations will be found upon the dark and bright spots and jets on the envelope *D*, particularly at the Observatory of Hamilton College, Poulkova, Dorpat, and Munich.

BERLIN. BRUHNS. (*Astron. Nachrichten*, 1205, p. 73.)

"Durchmesser des Kerns (der Kern war rund), 5″.61."

(Ibid., p. 74.)

"Entfernung des äussern Randes des innern Sectors vom Mittelpunkt des Kerns in der Richtung des Schweifes, $19^h.5$ Sternzt. = 15″.91
Der Positionswinkel der Mitte des innern Sectors fand sich, $19^h.6$ Sternzt. = 230°.45
. . . . . Mitte des Schweifes . . . . . Positionswinkel, $19^h.6$ Sternzt. = 47°.51"

PARIS. CHACORNAC. (*Bulletin Obs. Imp. de Paris.*)

"La septième des enveloppes lumineuses que j'ai observées autour du noyau de la comète est actuellement en voie de développement.

"Le 7 octobre elle était déjà visible dans le voisinage du noyau, mais trop rapprochée et confondue avec la lumière de celui-ci pour qu'on pût en prendre des mesures."

FLORENCE. DONATI. (*Bulletin Obs. Imp. de Paris.*)

"Le 7, l'auréole qui s'était montrée le 4 pour la première fois avait un rayon transversal de 15″.7. Le diamètre du noyau était ce jour-là de 3″.3.

"Je vois encore la tache sombre, mais le trouble de l'atmosphère ne me permet pas d'y distinguer la partie claire du centre."

BRESLAU. GALLE. (*Astron. Nachrichten*, 1179, p. 40.)

"Der Kern des Cometen erschien wiederum als eine nach unten gekehrte Spitze. Von dem etwa 240° umspannenden Fächer war der letzte Sector rechts (von

etwa 40°) heute schwächer als die übrigen 200°, auch war die gestrige Schattirung darin nicht bemerkbar. Die unsymmetrische feine Umhüllung des Kopfes wie an den vorhergehenden Tagen."

Markree. Graham. (*Obs. of Donati's Comet*, 1858, *Markree*, p. 11.)

"The nucleus was elongated in the direction of the major axis of the interior envelope, that is to say, nearly at right angles to the axis of the tail, or, more exactly, forming an angle of 110° or 115° with the N. direction of the axis on the W. (preceding) side. The convexity of the brighter part of the internal envelope extended very little beyond 180°, and, of course, the curvature of the concave side was much less than on the last two occasions, — it did not differ much from a right line. The cusps were pretty well shown; a little blunted and irregular, however, in consequence of streams of light issuing from them, and turning off in the direction of the tail. The jet from the E. (following) cusp was projected outward nearly in the direction of the concave boundary of the crescent, and was wafted off in the direction of the tail, as if by a strong current. The fainter envelope was better defined than on any former occasion, and, I fancied, took several times the form of the other; once or twice I had the same impression concerning the nucleus. The tail itself, a little N. of the nucleus, extended farther out on each side than the line of continuation of the fainter envelope, so as to give the impression, by its continuation southward, of a still fainter nucleus external to the former. As usual, the E. side of the tail was decidedly brighter than the other."

Vienna. Hornstein or Weiss. (*Annalen der k. k. Sternw. Wien*, F. III. IX. p. 180.)

"Am 7 October war der Umriss des inneren Fächers weit weniger scharf als am 5; er hatte sich so vergrössert, dass der äussere Fächer kaum doppelt so gross war. Letzterer war schon sehr verwaschen. Beide waren elliptisch, so dass ihre Umrisse nahe in der Richtung gegen die Sonne die geringste Entfernung vom Kerne ergaben. Im äusseren Fächer, und zwar im umkehrenden Fernrohre an der linken Seite desselben, sah Herr Dir. Littrow einen fast runden, ziemlich dunklen Raum. Die Mittellinie des Fächers schien rechts von der Schweifaxe zu liegen. Die Breite des zwischen beiden Schweifästen befindlichen dunklen Raumes hatte zugenommen; allein dieser ganze Raum schien etwas heller und mit Lichtmaterie erfüllt zu sein. Ueberhaupt erschienen alle Partien des Schweifes mehr gleichmässig verwaschen als an den vorhergehenden Tagen; selbst in der Nähe des Kernes war dieser Umstand deutlich zu beobachten. Das diffuse Licht um den Kopf des Cometen war stärker als früher. . . . . .

"Der Kern hatte an Intensität zugenommen, aber die fächerartige Form beibehalten."

Munich. Lamont. (*Jahresbericht der k. St. bei München*, p. 18.)

"Erst am 7 Oct. war es möglich, eine weitere Beobachtung vorzunehmen. Die Form des Kometen ist in Fig. . . (Plate XLIX. 79) dargestellt. Der äussere Kopf war verschwunden. Die Ausströmung an der Sonnenseite war in der Nähe des Kerns sehr stark und die Helligkeit nahm weiter hinaus beträchtlich ab. Zu näherer Erläuterung habe ich das Gerippe Fig. . . (Plate XLIX. 80) entworfen. Ein ziemlich starker Strom ging vom Kerne ab in der Richtung *c a* und reichte hinaus bis zur parabolischen Begrenzung; ein Strom von gleicher Intensität ging in der Richtung *c d* aus, erstreckte sich aber nur bis *b*, d. h. bis auf die Hälfte des Zwischenraumes zwischen dem Kern und der Begrenzung; der Raum bei *b d* war von schwächerm Lichte erfüllet, und von hier aus schien das Licht in der Richtung gegen *e* in den Schweif hinauszufliessen."

Dorpat. Mädler. (*Beob. der Kaiserl. Sternw. Dorpat*, XV. p. 46.)

"Heiter mit Ausnahme eines leichten Abendgewölks, das jedoch die Sichtbarkeit des Cometen etwas verzögerte. — Die Ausstrahlung nimmt heut mehr als 270° ein. Sie ist gut begrenzt; im Ganzen von gleichförmigen Lichte, aber in ihrem Innern zeigen sich zwei dunkle Stellen inselartig die sich im Laufe des Abends gleich blieben. Zunächst um diesen Strahlenkreis eine schmale dunkle Zone ohne scharfe äussere Begrenzung, darauf die Schweifmaterie. — Die Spalte im Schweif ist breiter geworden.

Durchmesser des Kopfs,	$18^{h}\ 49^{m}.5$	$1''.995$
	19 34	2.233
Halbmesser der Ausstrahlung, ...	18 54	17.677
	19 40	19.869
	20 56	27.063
Richtung der Ausstrahlung, ...	19 11	205° 36′
	19 55	207 22.3
Richtung des Schweifs, ...	19 17	50 46
	19 59	48 11

Richtung der Mitte des grössern dunklen Flecks, vom Kopfe aus genommen, $19^{h}\ 14^{m}$: 268° 12′ aus einer Einstellung."

Altona. Pape. (*Astron. Nachrichten*, 1172, p. 316.)

"Octbr. 7 trat der Comet nur wenige Minuten zwischen Wolken hervor. Ich sah nur flüchtig, dass auf der rechten Seite der Sector sehr verwaschen war, dass es wenigstens Mühe machte, hier seine Grenzen von dem hellen Grunde, auf dem er lag zu scheiden. Ich erhielt noch folgende Messungen:

$6^{h}\ 37^{m}$ Pos.-Winkel des Sectors = 226°.25

" " Schweifes = 44.25"

Observatory of Hamilton College, Clinton, N. Y. C. H. F. Peters. (*Mss.*)

"On the whole, the aspect is about the same as yesterday. Paid particular attention to the *streams of light*, of which, curiously enough, there appear two principal ones, parallel to each other, and both in the direction towards the sun: the one proceeding from the top of the nucleus, and the other from a concentrated globe of light (*secondary nucleus?*) distant about 10 seconds to the left from the nucleus, and connected with it by a bridge of light. Both these streams do not quite reach the edge of the inner corona, the second crossing the dark spot. From their basis, as well as along their stems, numerous little streams are branching off, those from the stem forming an acute angle towards the vertex, those arising from the nucleus (to the side of the large stream) tapering from its centre. There is a continual flow of light in these different rays, resembling most nearly the flow of electricity from a point placed upon the conductor as seen in the dark. The prolongation of the inner corner of the black spot to the left on the corona may be traced as a fine dark line to within a short distance from the nucleus."

Geneva. Plantamour. (*Note sur la Comète de Donati*, p. 8.)

"Le 7 octobre, à 7 heures du soir, l'échancrure dans l'espace sombre, dans laquelle se trouve le noyau, est encore plus prononcée que le 6; cette partie sombre remonte des deux côtés du noyau, et il semble parfois comme si elle l'entamait, en lui donnant un peu l'apparence d'une ombre produite par une phase."

Kremsmünster. Reslhuber. (*Astron. Nachrichten*, 1169, p. 263.)

"Himmel sehr rein; schönste Erscheinung des Kometen; der Kern ist wieder frei, 10-12 Bog. Secunden im Durchmesser. Die jüngste Enveloppe erweitert und entfernt sich mehr vom Kerne, umfasst auf der Vorderseite diesen fast in Halbkreisform, die Hinterseite offen lassend; die vorletzte Enveloppe parabolisch mit etwas matterem Lichte verfliesst mit ihren Enden in den Schweifästen, welche, vom Kern aus durch eine längere Strecke getrennt, erst im grösserer Entfernung sich vereinigen."

Vienna. Schmidt. (*Mss.*) (For the notation, see Oct. 4.)

"$5^h\ 44.0^m$	$r' =$	$26.19''$	11 Beob.
5 55.2		29.10	10 "
6 59.5		35.76	10 "
7 55.5		39.68	10 "
6 14.0	$r'' =$	53.25	10 Beob.
7 7.2		56.54	10 "

"Kleine Wolke im Sector, deren Abstand vom Kerne des Cometen

$6^h 24^m.7$	$\varrho = 19''.57$	10 Beob.
7 14.5	15.25	10 "

Sehr schwierige Beob."

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 14.)

"Avendo io veduto la Cometa la sera del 7 con bellissimo cielo a Berlino nel grande refrattore per gentilezza del Signor Encke, la sua figura non mi parve ancora divenuta distorta, ma solo quale si rappresenta nella figura. Se non che mi parve oltre il foro nero tra l' aureola e il nimbo esservi più interruzioni chiare ed oscure che decisamente richiamavano una struttura del nimbo a raggi debolissimi. Il nucleo dalla parte dell' aureola era notabilmente più sfumato, che dalla parte della coda."

Poulkova. O. Struve. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 9–11.)

"Seit der letzten Beobachtung scheinen wesentliche Veränderungen am Kopfe des Cometen vorgegangen zu sein. Der Kern erscheint elliptisch und im Fächer ist eine dunkle enge halbkreisförmige Spalte zu bemerken, deren Zusammenhang nur durch einen vom Kern ausgehenden mehrere Secunden breiten helleren Strahl unterbrochen wird, der, allmälig an Intensität verlierend, bis über den äusseren Halbbogen hinaus verfolgt werden kann. Auf dem von dieser Spalte nach innen belegenen Theile des Fächers ist das Licht nicht gleichförmig, sondern zeigt, ausser dem erwähnten Strahle, einen erheblich helleren Fleck, von 4″ Durchmesser, in nordwestlicher Richtung vom Kern. Auf der nachfolgenden Seite läuft der Fächer in zwei Spitzen aus, die nahezu von gleicher Helligkeit sind. Von den drei Spitzen des Fächers ziehen sich Lichtfäden zu den hellsten Stellen des Schweifs hin. Der Halbbogen geht allmälig in den Schweif über.

Messungen und Schätzungen.

$20^h\ 0^m$ — $20^h\ 45^m$.

1. Am Kern und Fächer.

Grosse Achse des Kerns, Richtung 237°, Ausdehnung 6″
Kleine " " Ausdehnung 3″
Heller Fleck im Fächer, Richtung 290° Abstand 6″
Mittlerer Abstand der dunklen Spalte, vorangehend 12″
" " " " " nachfolgend 10″
Richtung des vom Kern ausgehenden langen Strahls 222°.5
" der nordwestlichen Spitze des Fächers 323
" " südöstlichen " " " 122
" " nordöstlichen " " " 72

Begränzung des Fächers

in der Richtung	323°	Abstand	$2^r.57$	=	$25''.0$
" "	303	"	2.62	=	25.5
" "	227	"	2.30	=	22.4
" "	187	"	2.33	=	22.7
" "	129	"	3.23	=	31.5
" "	75	"	1.96	=	19.1

2. Am Halbbogen.

Richtung der äussersten deutlich erkennbaren Theile des Halbbogens
auf der vorangehenden Seite, 359°
" nachfolgenden " 101

Begränzung des Halbbogens

in der Richtung	355°	Abstand	$7^r.33$	=	$71''.3$
" "	316	"	5.47	=	53.2
" "	244	"	4.36	=	42.4
" "	189	"	4.55	=	44.2
" "	101	"	7.80	=	75.9

"Die Breite des dunklen Zwischenraums zwischen Fächer und Halbbogen beträgt heute nahezu die Hälfte von der des hellen Halbbogens oder beiläufig 7″.

"Der südliche Nebeldunst hat heute nur eine Ausdehnung von 8′ in der Richtung des Declinationskreises.

"Für den dunklen Zwischenraum zwischen den beiden Schweifhälften, der jetzt viel breiter geworden, aber zum Theil mit Nebelmaterie gefüllt ist, wurde gefunden:

Richtung der vorangehenden Seite, 35°.0
" " nachfolgenden " 50°.0

"Diese Richtungen sind die mittleren bis etwa 6′ Abstand vom Kern."

Poulkova. Winnecke. (*Pulk. Beob. des Grossen Cometen* 1858, p. 21.)

"19^h 11^m Sternz. $D = 2''.62$. 3 Beob."

(Ibid., pp. 24 – 26.)

"Bei heftigem Sturme klärte es sich nach einem starken Regengusse um 6^h auf; der Comet war, als ich ihn um 19^h 0^m Sternz. einstellte, schon sehr gut mit freiem Auge zu sehen und sein Schweif etwa $\frac{1}{2}°$ weit zu verfolgen.

Innerer Sector. 19^h 40^m. $d = 20''.0$. 2 Beob.

Positionswinkel: Kern bis äusserste Spitze rechts, 130°.6. 3 Beob.
" " " " " links, 336°.8. 3 "

"Es ist heute ein zahnförmiger Auswuchs an der rechten Seite des innern Sectors. Die vorangehende Seite des Zahnes ist vom Kerne um einen seiner Durch-

messer = 3″ entfernt und es beträgt die Breite desselben an der Basis 0.3 — 0.4 des Abstandes der äussersten rechten Spitze des Sectors vom Kerne.

"Länge desselben gleich Dreiviertel vom Scheitelradius des Sectors.

Positionswinkel der äussersten Spitze des Zahnes vom Kerne, 67°.4. 2 Beob.

" " Richtung des Zahnes selbst, . . . 61°.4. 2 "

"Die Lichtstärke dieser Erscheinung war vielleicht etwas schwächer, als die des Sectors selbst.

"Das Loch und der secundäre Kern. Um 19^h 15^m bemerkte ich eine Ausströmung vom Kerne innerhalb des kleinern Sectors in der Richtung 318°.9. 3 Beob. Als es dunkler wurde, nahm diese Ausströmung mehr die Form eines secundären schwächern Kernes an, dessen Entfernung vom Hauptkerne 2″.7 (einen Durchmesser des Kernes) betrug.

"19^h 50^m. Positionswinkel des secundären Kernes vom Hauptkerne aus, 303°.1. 2 Beob.

"Dieser Lichtknoten war umgeben von einem halbkreisförmigen Raume, dessen Helligkeit bei weitem schwächer war, als die des übrigen Sectors. Die Lage des secundären Kernes darin war analog der des hellern Kernes im hellen Sector.

"Richtung des Scheitels dieses dunklen Sectors vom Hauptkerne ab = 295°.5. 3 Beob., der Scheitelradius desselben beträgt etwa $\frac{2}{3}$ von dem des hellen Sectors. Im nordöstlichen Theile des Sectors war noch ein dunkler Fleck; Herr Wagner, welcher ihn zuerst bemerkte, sah ihn mit mehr Bestimmtheit als ich.

"Grosser Sector, 20^h 0^m. $d' = 38''.8$. 3 Beob.

"Er hat sich nicht wesentlich geändert; der lichte Streif rings in ihm, war etwa halb so breit, als der Abstand seiner äussern Begränzung vom innern Sector. Correspondirend der dunklen Stelle im innern Sector zeigte sich in derselben Richtung eine nicht unbedeutende Schwächung des Lichtes im äussern Sector, aber im Verhältniss bei weitem schwächer. Der Schweif ging bestimmt nicht um den äussern Sector; er schloss sich an die Seiten desselben an, wie es in der Figur für diesen Tag angegeben ist. Später, bei tieferem Stande konnte man übrigens diese Gewissheit nicht erlangen und Herrn Wagner schien er bis vor den Sector zu liegen, obgleich dieser zuvor eher der Meinung war, dass die verlängerte Richtung der Schweifbegränzung den Sector schnitte.

"Die schwache Umhüllung wie früher. Positionswinkel der Aufblähung 175°.5, Abstand vom Kerne in dieser Richtung 7′.5.

Abstand vom Kerne in der Senkrechten auf die Schweifaxe durch den Kern vorgehend . . . . 3′

Abstand vom Kerne in der Senkrechten auf die Schweifaxe durch den Kern folgend . . . . 6′.5"

(Ibid., p. 32.)

"19^h 55^m Sternz. $p = 48°.11$. 6 Beob."

1858. October 8. (Plate XLIX. 83-89.)

The dark and bright spots in D remain still in sight. There is as yet no new envelope, although the nucleus, from its increased brightness, gives indications that one is at hand.

The preceding (apparent left-hand) side of the envelopes, which has been gaining in decision and brightness for a week or more past, has now rather the advantage in point of distinctness. We shall see that this was shortly succeeded by a similar, though less decided, change in the two branches of the tail and in the form of the envelopes.

The traces of the remains of earlier envelopes considerably below the nucleus, intersecting the branches of the tail somewhat transversely, is a curious feature on this and succeeding dates.

Göttingen. Auwers. (*Astron. Nachrichten*, 1167, p. 235.)

"Durchmesser des Kerns $\doteq 2''.74$."

Observatory of Harvard College. G. P. Bond.

The following measurements were taken:—

Nucleus to d', vertex of D,	$28''.0$
Transverse diameter of D in the direction $d\,d''$ (difficult to measure),	61.8

The longest diameter is now through the nucleus.

Transverse diameter of C in the direction $c\,c''$,	123.5
Nucleus to c', vertex of C, rather ill defined,	48.5
Angle of position of dark stripe,	$58°\ 30'$
" " " tangent to the outline of C at c, preceding side,	36 35
" " " " " " c'', following side,	79 5
Diameter of nucleus,	4.4

The nucleus to-night is decidedly brighter than on the 6th, and is preparing to throw off a new envelope. The breadth of the dark arc outside of D is between one half and one third of the distance between D and C. (By this estimate the breadth of the arc is, at the vertex, $4''.4$, and at the intersection with the transverse diameter, $12''.9$.) The outlines are plainest on the preceding side, the previous order being now reversed. On the preceding side, below the nucleus, there are traces of another dark outline outside of B, and others were suspected in the same vicinity. D is rather brighter on its southern margin, just outside of which the light of C encroaches upon the dark halo, apparently the

remains of the jet or streamer noticed on Oct. 5th, in this vicinity. The interior of *D* is still in a tumultuous state, but the convolutions are not as plain as on the 6th.

The dark spot (of the 3d) seems to be divided into two, in a sketch which was made of it.

The angle of position of a point midway between the two openings is, ...	$226^\circ.0 + 58^\circ\ 30' = 284^\circ\ 30'$
Distance, ...	$14''.2$
From a chalk drawing, ...	$226^\circ.0 + 58^\circ\ 30' = 284^\circ\ 30'$
Distance, ...	$19''.3$

The opening has developed for several days past about in the same proportion as the rest of the envelope, and maintains very nearly its original position in it.

The light of the envelopes is altogether too strong to allow of seeing a star of less than the 10th magnitude near them. I think the nucleus, by the mere excess of its light, would obliterate a star of the 9th magnitude if within ten or twenty seconds of it.

Cambridge, Eng. Breen. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 17.)

"Sketches on these days [Oct. 8 and 9] represented a wing-shaped envelope attached to the nucleus, the arch, as usual, farther off, with coma beyond, and the space dark under the nucleus."

Cambridge, Eng. Challis. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 19.)

"'Mottled appearance about the envelope (i. e. the space between the exterior arch and the bright central fan). The left-hand patch seen, but not the bright spot. Apparently a greater divergence of the coma; the right-hand stream still the brighter.' The central fan, as shown in a drawing (Plate XLIX. 86), was spread out farther than on Oct. 6."

Haddenham. Dawes. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 90.)

"During broad daylight I set the equatorial to the place of the Comet indicated by Farley's ephemeris. On applying my eye to the telescope at $5^h\ 20^m$ G. M. T., while the sun was shining brightly into the observatory, the Comet was instantly seen in the centre of the field. This was the only occasion on which I was able to detect it while the sun was above the horizon; though at the time noted it was so plainly seen that I think it probable it might have been perceived at least ten minutes sooner. On two or three days I think it might have been perceived if the sky had been free from haze; but the effect of a very slight film of haze, when acted upon by the sun, is fatal to the visibility of such an object.

COMET OF DONATI 1858.

OCTOBER 6TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE. PLATE XXXVIII

G.P. Bond Del. J. W. Watts Sc.

COMET OF DONATI 1858.

OCTOBER 8TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE. PLATE XXXIX

Printed by Chas. D. Andrews

"On examining the form of the nucleus as thus seen during sunshine, I was immediately struck with its *elongated* and even *crescent* shape, the convexity being towards the sun. This was the whole of the Comet which was visible; and it certainly gave me a strong impression of its *solidity* and *opacity*, as presenting a true *phase;* and thus satisfactorily accounting for the dark line extending from it in the direction of the axis of the tail. As the daylight diminished, the distinct outline of the nucleus was rapidly lost through the brightness of the coma immediately in contact with it.

"7^h 30^m. The Comet is finely seen. The bright nucleus is much smaller than it was. A small, bright, semicircular arch surrounds it on the sunward side, and a much larger arch, not so bright, outside of it, which becomes decidedly brighter towards its outer edge. And exterior to that, on the *western* side and only a few seconds from it, there is a portion of a *third* arch, extending *sunwards* for a few seconds, and it is then gradually lost in the faint nebulosity which surrounds the sunward side of the larger arch. There is a *bright spot* of rather irregular shape (rather *pear-shaped,* with the smaller end towards the nucleus) on the western side of the nucleus; and a streak of light extending almost directly sunward from the smaller arch to the edge of the larger arch. The middle radius of the exterior sector makes an angle of about 188° with the direction of the dark channel as deduced from my sketch (Plate XLIX. 89) of its appearance."

Florence. Donati. (*Bulletin Obs. Imp. de Paris.*)

"Le 8, rayon transversal de l'auréole 18″.9. — Diamètre du noyau 3″.6. — J'aperçois la tache sombre et sa tache lumineuse centrale."

Markree. Graham. (*Obs. of Donati's Comet* 1858, *Markree*, p. 11.)

"The most striking change apparent to-night is in the nucleus, which now flames out so as to form a semicircular, rather semi-elliptical corona, on the side next the sun, the cusp on the E. (following) side being lopped off, so that the boundary line is southeastward; the other (western) cusp seems at times to flare off southward, as if impelled by a current. The interior envelope partakes of the form of the corona, nearly semi-elliptical, undefined on the E., going off into the tail at rather a greater angle with the axis than the general direction of the east side of the latter. On the southwestern side of this envelope the dark spot, observed on Oct. 5, is visible, rather smaller in proportion than on the former occasion; several times it was fancied that the western side of this envelope, in its concavity, partook slightly of the caustic form. The next succeeding envelope, of lighter texture, seemed also somewhat of a crescent, though still very like the

tail in material. For a small distance on the S. W. side there is a well-defined very narrow line of light forming its boundary line. At some distance N. of the nucleus, the tail extends out in breadth beyond the line of direction of the envelope. On the E. side the widening is gradual, being formed apparently by matter shot out from the interior envelope; on the W. it is quite abrupt. The continuation of the expansion of the tail round the head consists of very subtile matter fading off into the blue sky without any definite outline."

(Ibid., p. 12.)

"We omitted to mention that the tail near the nucleus consisted, as heretofore, of two streams of light, leaving a dark parabolic space in the centre, with the nucleus at its vertex."

Liverpool. Hartnup. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 56.)

"Diameter of nucleus,	22″
Diameter of first envelope,	1′ 52
Diameter of second envelope,	5 37
Distance from centre of nucleus to front of coma,	3 36
Diameter of coma at right angles to tail, measured through centre of nucleus,	8 46
Length of tail, measured along the curve on the convex side,	39° 30′
Distance from nucleus to end of tail in a straight line,	35 0
Greatest diameter of the tail,	7 30

"Decided dark spots were seen in the coma near the nucleus; one on the 8th and two on the 11th of October.

"It [the shadow] was rendered invisible by the increased darkness of the band which passed through the centre of the tail."

Bradstones. Lassell. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 79.)

"There remained only a trace of the dark spot in the 2d envelope seen on the 4th and 5th insts., but the whole of this envelope had assumed a mottled appearance."

Vienna. Littrow. (*Annalen der k. k. Sternw. Wien*, F. III. IX. p. 181.)

"Am 8 October sah Herr Dir. Littrow ausser dem am 7 bemerkten dunklen Fleck im Fächer, welcher sich wieder bedeutend vergrössert hatte, zwei andere auf der rechten Seite; sie waren kleiner und nahe rund. Auch an diesem Tage war die rechte Seite des Fächers die hellere. In der Dämmerung konnte sehr deutlich gesehen werden, dass der Fächer nicht allmälig in den Schweif überging, sondern von ihm sich entschieden abgrenzte."

Dorpat. Mädler. (*Beob. Kaiserl. Sternw. Dorpat*, XV. p. 47.)

"Um 18^h 20^m den ersten Blick erhalten; Messungen gelangen erst 12 Min

später.—Anfangs ganz heiter, später Gewölk, das dichter werdend den Schluss der Beobachtungen um 20^h 15^m herbeiführte.

"Die eigenthümliche Figur des Strahlenkreises zeigte sich in gleicher Art wie gestern, ausser dass er sich nur wenig über 180° herum erstreckte.

Durchmesser des Kopfes,	18^h 35^m . .	1″.570
	Richtung, 0°	
	18^h 44^m . .	1″.647
	Richtung, 34°	
	18^h 47^m . .	1″.647
	Richtung, 124°	
Mittel aus allen 3 Best.,	1″.621	
Richtung der Ausstrahlung,	18^h 50^m . .	227° 13′.3

Halbmesser der Ausstrahlung:

18^h 54^m .	20″.875
19^h 17^m . .	24″.398

"Der Augenschein zeigte schon ohne Messung, dass der Halbmesser sich vergrössert hatte. Später zeigte sich die Peripherie nicht mehr scharf genug zur Messung."

Altona. Pape. (*Astron. Nachrichten*, 1172, p. 316.)

"Der folgende Abend, Octbr. 8, zeigte den Cometen ganz ähnlich wie Octbr. 6. Der Sector hatte 7^h 0^m bei einem Radius von etwa 30″ einen Umfang von 180°; an der linken Seite sah ich auf Augenblicke einen feinen dunklen Streifen. Das Object war offenbar für das benutzte Fernrohr zu fein. Ich führe diese Wahrnehmung nur an, weil sie sich durch die Beobachtungen anderer Astronomen mit grösseren Fernröhren bestätigt hat. Die Erscheinung des Cometen war sehr verwaschen, die dunkle Mittelzone schlecht begrenzt und erheblich breiter als früher. Auffällig war die Helligkeit des Schweifastes an der untern linken Grenze des Sectors. Die Messungen ergaben

6^h 25^m Pos.-Winkel des Sectors, = 229°.25
" " Schweifes, = 52°.60.

"Ich habe bislang über die Erscheinung des Schweifes wenig hinzugefügt, weil sie sich nahe gleich blieb."

Madras. Powell. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 65.)

"Nucleus about as bright as *Mars* or *α Lyræ*."

Vienna. Schmidt. (*Mss.*) (For an explanation of the notation, see Oct. 4.)

h m		″	
" 5 56.2	r' =	32.59	10 Beob.
6 32.7		38.32	10 "
7 24.0		42.74	10 "

$6^h\ 8^m.7$	$r'' = 52''.92$	10 Beob.	

Kleine Wolke im Sector.

$5^h\ 56^m.2$	$\varrho = 14''.50$	10 Beob.
6 3.5	14.64	10 "
6 44.2	19.58	10 "

Sehr schwierig."

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 14.)

"Alle 8 si trovò il suo aspetto fortemente cambiato e la forma del nimbo era divenuta irregolare assai, esso pendea molto dalla parte verso est apparente."

Oxford, Eng. Slatter. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 25.)

"*Nucleus* much larger, irregular in shape, but not sensibly differing from a parabola. Longer diameter 22″ (shorter 11″ by estimation).

"*Envelope* very large, the posterior angle much more open; estimated at 150°. Parameter 83″. Inside the nucleus was a yet brighter very small nucleus, estimated at 2″ or 3″ diameter; in shape round."

Poulkova. O. Struve. (*Pulk. Beob. des Grossen Cometen* 1858, p. 11.)

"Vom 7 auf den 8 October hat sich das Licht des Halbbogens sehr concentrirt, so dass derselbe der Breite nach kaum die Hälfte des dunklen Zwischenraums, der ihn vom Fächer trennt, einnimmt. Im Aussehen des Fächers und der ihn begränzenden Theile sind keine wesentlichen Veränderungen bemerkt. Aber der Kern erschien heute wieder kreisrund. Der vom Kern ausgehende helle Strahl, der gestern bis über die äussere Begränzung des hellern Halbbogens zu verfolgen war, erstreckte sich heute, mit abfallendem Lichte, nur bis zur Mitte des dunklen Zwischenraums. Messungen und genauere Wahrnehmungen konnten heute keine gewonnen werden."

Poulkova. Winnecke. (*Pulk. Beob. des Grossen Cometen* 1858, p. 21.)

"$20^h\ 0^m$ Sternz. $D = 3''.45$. 2 Beob.

"In heller Dämmerung ziemlich gut begränzt, rund und planetarisch. Ein Planet würde in dieser Zenithdistanz nicht besser begränzt erscheinen."

(Ibid., p. 26.)

"Es wurde gegen Abend ganz schön heiter, Comet eingestellt um $18^h\ 40^m$ Sternzeit; ausser dem Kerne und dem innern Sector Nichts weiter sichtbar.

"Innerer Sector. $19^h\ 30^m\ d = 23''.3$. 3 Beob.

Positionswinkel. Kern bis äusserste Spitze, rechts, 120°.2

" " " " links, 330°.0

"Die Fläche desselben erscheint nicht mehr gleichmässig, sondern gefleckt, ohne

dass man jedoch ausser dem grössern dunklen Loche Bestimmtes erkennen könnte. Vom Kerne ging ein heller Streifen aus, etwa in der Richtung des Apex des Sectors, aber so ungewiss, wenn man die Richtung einstellen wollte, dass eine Messung nicht gelang. Der dunkle Fleck war wohl noch symmetrischer zum Nebenkerne geworden, als gestern, auch hatte er sich offenbar vergrössert. Vom andern gestern gesehenen Flecke konnte ich heute keine Gewissheit erlangen. Die Begränzung des Sectors nach dem Schweife zu, war bei weitem nicht so scharf als früher. Es erscheint die ganze Trennungslinie ausgezasert, gleichsam, als wenn die Materie des Sectors dort jetzt an der ganzen Fläche in den Schweif überströmte. Der Zahn, vielleicht der erste Durchbruch, war gänzlich verschwunden.

"Der secundäre Kern. Bei dem ersten Hineinblicken in das Fernrohr auffallend und der Positionswinkel messbar; vier Einstellungen ergaben ihn 306°.2, Abstand vom Kerne $1\frac{1}{2}$ Durchmesser dieses. Sein Licht war übrigens bei weitem matter, als das des Hauptkernes, auch sein Durchmesser kleiner.

Aeusserer Sector. 19^h 30^m. $d' = 37''.3$. 3 Beob.

"Vorn sehr gut begränzt, auch an den Seiten. Die Enden scheinen sich jetzt viel allmäliger in den Schweif zu verlaufen, als früher; sie reichen auch weiter hinab. Die Breite der hellen und dunklen Zone des Sectors (Ring) gleich. Siehe die Figur. (Plate XLIX. 88.) Eine dem dunklen Theile im innern Sector entsprechende Lichtabschwächung bemerkte ich heute nicht. Ob sich Materie des Schweifmantels bis vor den äussern Sector erstreckte, liess sich nicht mit Gewissheit wahrnehmen. In der Dämmerung schien es mir so, später konnte ich sie nicht bemerken.

Die äussere Umhüllung. Positionswinkel der Aufblähung, = 180°. 1 Beob.

Abstand der Begränzung derselben vom Kerne in dieser Richtung 9′.

Abstand vom Kerne in der Senkrechten auf die Schweifaxe durch den Kern, links, ... 4′

Abstand vom Kerne in der Senkrechten auf die Schweifaxe durch den Kern, rechts, ... 8′"

(Ibid., p. 33.)

"19^h 45^m Sternz. $p = 54°.79$. 6 Beob.

"Die Zone im Innern des Schweifes ist heute bei weitem nicht mehr so dunkel als früher; an den Rändern des Schweifes und auf zwei bis drei Minuten Abstand von ihnen ist die Helligkeit, wie immer, sehr viel grösser."

1858. October 9. (Plates XL. and XLIX. 90-98.)

A new envelope, *E*, appeared on the 9th, close to the nucleus. The whole or parts of four different envelopes were now visible besides the exterior haze.

Observatory of Harvard College. G. P. Bond.

"A new envelope, *E*, has been thrown off, as predicted last evening. It is very bright, its lower edge sharply truncated, the line making a sensible angle with the dark stripe of the axis, which comes up full and square to the nucleus. The formation of a new envelope is preceded by an increased brightness and size of the nucleus. At its first appearance, it is exceedingly brilliant, and the nucleus, though its light is still more intense than that of the envelope, is smaller and fainter than before.

"The following measurements were taken: —

Transverse diameter of new envelope *E* in the direction $e\,e''$,	16.″2
" " " envelope *D* in the direction $d\,d''$,	75.6
" " " envelope *C* in the direction $c\,c''$,	123.6
Nucleus to e', vertex of *E*,	7.6
" d', " *D*,	34.4
" c', " *C*,	52.5
Angle of position of the straight line under the nucleus, terminating the dark axial stripe, and the lower edge of the new envelope,	137° 5′
Breadth of the dark axial stripe 3′ from the nucleus,	11.4
Angle of position of the dark axial stripe,	62 38
Angle of position of the tangent to the outline of *D* on the preceding side at *d*,	40 25
Angle of position of the tangent to the outline of *C* on the preceding side at *c*,	43 40
Angle of position of the tangent to the outline of *D* on the following side at d'',	77 0

"The envelopes still set awry over the axis of the tail." (It is to be noticed, however, that the measured angles of position of the tangents of the envelopes do not indicate this peculiarity, which may, perhaps, be partly due to the distribution of their light.)

"I think that the outlines of *B* and *C* are still discernible below the line of the nucleus. From a sketch, the transverse diameter of *B*, in the direction of $b\,b''$ is 172″.

Ann Arbor. Brünnow. (*Mss.*)

"On the next clear evening, Oct. 9, this condensation had disappeared, but in the same direction there was a jet of light ejected from the nucleus, above it a comparatively dark spot. The rings were not symmetrical to the nucleus, but were the farthest from the nucleus, and also brighter, where the jet of light was. The intervals between the rings were filled again with some light matter."

COMET OF DONATI 1858.

OCTOBER 9TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE. PLATE XI.

G. P. Bond Del.

J. W. Watts Sc.

COMET OF DONATI 1858.

OCTOBER 10TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE. PLATE XII.

Printed by Chas D. Andrews

Paris. Chacornac. (*Bulletin Obs. Imp. de Paris.*)

"La septième des enveloppes lumineuses que j'ai observées autour du noyau de la comète est actuellement en voie de développement. . . . . .

"L'enveloppe qui se dégage du noyau sous forme de spirale est la quatrième que j'aie vue se détacher graduellement et former en s'élargissant la portion lumineuse de la tête de la comète."

(Ibid.)

"Le 9 octobre, M. Desains a bien voulu contrôler les observations que j'avais faites sur la lumière polarisée qu'offre la comète. Je lui ai fait ensuite remarquer que l'arc lumineux formant la septième enveloppe présentait un petit point noir de forme triangulaire, situé à peu près à la moitié du rayon vecteur incliné de 45° environ sur l'axe de la queue.

"L'aspect du point noir, vu dans la grande lunette, ressemblait à une ouverture de l'enveloppe; celle-ci paraissait, ainsi que le noyau, être déformée. La lumière était distribuée également autour du rayon vecteur passant par le point noir, et elle formait à sa limite une protubérance dans le sens du prolongement du rayon."

Cambridge, Eng. Challis. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 19.)

"'The angular divergence of the streams of coma greater, and the light more diffused; the comet altogether less bright. The bright part of the nucleus and the hood appeared smaller. Clouds about, and the sky unfavorable. The axis of the cusp and nucleus not coincident with the axis of the tail.' (This appearance was probably owing to the *left* side of the envelope being now extended farther than the right in the direction of the tail.)"

Florence. Donati. (*Bulletin Obs. Imp. de Paris.*)

"Le 9, le ciel était nuageux. — Diamètre du noyau 4″.6."

Christiania. Fearnley. (*Astron. Nachrichten*, 1242, p. 274.)

"Am 9ten bei ziemlich guter Luft war der Flecken nicht mehr zu erkennen. Ein feiner dunkeler Streif berührte den vorangehenden Rand des ersten Nimbus und zog sich in der Position 330° – 340° über den zweiten Nimbus hin, erreicht aber kaum die Grenze desselben. Auch auf der anderen Seite des inneren Nimbus schien mir eine schwache Andeutung zu einem mit dem ersteren symmetrischen Strich oder Streif zu sein. Bei genauer Untersuchung fand ich den ersten Streif durch Contrast hervorgerufen, indem er die äussere Grenze bildete von einem anfangs nicht bemerkten, aber deutlichen, vielleicht parabolisch geförmten zarten Lichtschleier. Dieser auch unwendig, d. h. nach der dunkeln Spalte hin scheinbar gut begrenzte Schleier war etwa 8 bis 10 Secunden breit, konnte

aber nur da gesehen werden, wo er sich auf den hier etwas matten Hintergrund des zweiten Nimbus projicirte."

(Ibid., p. 275.)

"Oct. 9, Durchmesser des Kerns 1″.8 in naher Uebereinstimmung mit Mädler."

Dorpat. Mädler. (*Beob. Kaiserl. Sternw. Dorpat,* XV. p. 48.)

"Der Wind noch immer störend; übrigens ganz heiter. Um $18^h\ 26^m$ den Cometen ohne Schwierigkeit gesehen; der Kopf erscheint noch kleiner als gestern: die Messungen ergeben:

	$18^h\ 38^m$	1″.432
	$18^h\ 46^m$	1″.367
	$19^h\ 19^m$	1″.608

"Mittel aus 3 Bestimmungen: 1″.469. Für die kreisförmige Ausstrahlung ergab sich:

Richtung:

$18^h\ 53^m$	237° 48′.3
$19^h\ 30^m$	238° 17′.3

Halbmesser:

$18^h\ 57^m$	23″.429
$19^h\ 38^m$	29″.339

"Die Ausstrahlung erstreckte sich auf 200° des Umkreises, später bei zunehmender Dunkelheit auf jeder Seite noch 15°–20° weiter, jedoch mit matterm Lichte. Die linke (vorangehende) Seite heller als die rechte; in diesem hellern Theile 2 dunkle Streifen in schräger Richtung und etwas gekrümmt (concav gegen den Kopf zu). In der rechten Hälfte erscheint die Strahlung zwar auch nicht gleichförmig; das matte Licht lässt jedoch keine bestimmte Gestalten im Innern erkennen. — Besonders deutlich und bestimmt zeigte sich heute ringsherum die dunkle Zone zwischen dem Strahlenkreise und der Schweifmasse. — Die dunkle Spalte im Schweife wird jetzt allabendlich breiter und augenfälliger:

Richtung des Schweifes:

$19^h\ 7^m$ . . 56° 8′."

Greenwich. Main. (*Monthly Notices Royal Astr. Soc.,* Vol. XIX. p. 14.)

"The bright point exhibits more of a planetary character than when I last saw it. The inner disk is of a silvery whiteness, and is complete on the apparent upper side of the nucleus; the lower part being cut off by the dark shadow, which is much more diffused, but very dark immediately under the nucleus, spreading out into a parabolic form, leaving two branches of the envelope of considerable brightness on each side. The outer annulus is visible and well defined; but the lower part of it assumes more of a parabolic character, and seems to throw out streams, merging in the two branches of the envelope."

(Ibid., p. 15.)

"Distance of bright point to outer edge of the inner disk (4 measures) [in the direction of the axis of the envelope], ... = 16″

Distance of bright point to outer edge of the outer annulus (2 measures) [in the direction of the axis of the envelope], ... = 38″

"Inclination of axis of the envelope to the meridian 64° to the east; the train diverging upwards."

Altona. Pape. (*Astron. Nachrichten*, 1172, p. 317.)

"Der folgende Abend, Octbr. 9, bestätigte im Allgemeinen die gestrigen Wahrnehmungen. Der Sector hatte an Helligkeit etwas abgenommen, sein Radius war wieder gewachsen und wohl nicht kleiner als 33″, während der Scheitelradius der ihn umgebenden Zone nahe derselbe (45″) geblieben war. Die linke Seite des Sectors und der vorangehende Schweifast war erheblich heller als die gegenüberliegende Seite, die Erscheinung im Allgemeinen sehr verwaschen.

"Ich erhielt folgende Pos.-Winkel:

$6^h\ 22^m$ Sector, = 244°.15
Schweif, = 59°.15."

Geneva. Plantamour. (*Note sur la Comète de Donati*, p. 8.)

"Le 9 octobre, à 6 heures 50 minutes du soir, l'apparence de la comète n'a pas changé sensiblement depuis le 7; seulement, le rapport du diamètre du noyau à celui de l'enveloppe intérieure formant la tête me paraît celui de 1 à 3, tandis que les jours précédents il était de 1 à 5."

Vienna. Schmidt. (*Mss.*) (For explanation of the notation, see Oct. 4.)

$6^h\ 52^m.3$	$r' =$	$10''.35$	13 Beob.
7 18.7		16.52	10 "
7 34.0		19.32	10 "
6 44.7	$r'' =$	43.26	10 Beob.
7 9.5		45.31	10 "
7 32.4		47.55	10 "

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 14.)

"Queste apparenze mutarono affatto la sera del 9, in cui sfortunatamente manca l' osservazione del Donati. Ecco quanto trovò nel giornale. 'Dopo un lungo aspettare, finalmente la Cometa è uscita dalle nubi. La prima cosa che ha colpito è stato vedere non due ventagli, (cioè l' aureola e il ventaglio o nimbo propriamente detto) ma tre: cioè il più grande meno lucido, il medio un poco più splendente, e il 3° più intero più deciso e più lucido degli altri, oltre la solita nebulosità

esteriore diffusa. Il *ventaglio* grande si è slargato alle due parti laterali che ora confondonsi nella coda (vedi fig. precedente ove era lateralmente rientrante) (Plate XLIX. 94), anche l' ombra del nucleo ossia l' asse centrale oscuro della coda si è slargato, e sembra che le due quasi capigliere che formano la coda tendano a circondare nuovamente il nucleo per rendere la nebulosità rotonda come vedeasi al principio dell' apparizione.' "

OXFORD, ENG. SLATTER. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 25.)

" *Nucleus* large, paraboloidal, with a brighter core. Diameter of outer nucleus 31″; inner ditto, 9″. *Envelope* has vanished; no trace whatever of any."

POULKOVA. O. STRUVE. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 11–13.)

"Bei günstiger Luft konnten heute die Details der Erscheinungen am Kopfe des Cometen recht scharf wahrgenommen werden. Kern sehr präcise und kreisrund. Der vom Kern ausgehende Strahl konnte wieder bis einige Secunden jenseits der äussern Begränzung des hellen Halbbogens verfolgt werden. Ein anderer noch intensiverer aber kürzerer Strahl ging, am Kern einen spitzen Winkel mit dem längern Strahle bildend, diesem voraus, und in fast nördlicher Richtung, etwas aus der regelmässigen Begränzung des Fächers heraustretend, lag noch ein heller Lichtpunkt (*a*), in wenigen Secunden Abstand vom Kern und von geringem Durchmesser. Die vorgestern bemerkte Spalte war heute auf der nachfolgenden Seite verschwunden, und hatte auf der vorangehenden eine unregelmässige Gestalt angenommen. Näher zur Peripherie des Fächers und ungefähr in der Richtung des kurzen hellen Strahls, zeigte sich noch eine dunklere Stelle, gewissermassen ein Loch im Fächer, dessen Gränzen aber verwaschen und unbestimmt waren. Zwischen diesem Loch und der Spalte, war ein auffallend heller Punkt (*b*) zu sehen, von ein Paar Secunden Durchmesser, aber nicht scharfer Begränzung. Auf der nachfolgenden Seite des Fächers waren noch die beiden Spitzen zu erkennen; die nordöstliche hatte aber sehr an Licht abgenommen und war entschieden sehr viel schwächer als die östliche. Ueber den dunklen Zwischenraum zwischen Fächer und Halbbogen finden sich keine specielleren Angaben in meinem Tagebuche; nach der noch denselben Abend angefertigten Zeichnung muss aber geschlossen werden dass dieser Zwischenraum wenig auffallend gewesen ist; es scheint dass der helle Bogen sich nach innen ausgedehnt hat und mit allmälig abnehmendem Lichte dem Fächer anschliesst.

Messungen und Schätzungen.

$19^{h}\ 12^{m}$ — $20^{h}\ 40^{m}$.

1. Am Kern und Fächer.

Durchmesser des Kerns $0^{r}.28 = 2''.7$.

Hellster kurzer Strahl, Richtung 243°, Ausdehnung $0^r.66 = 6''.4$
Langer Strahl, Richtung 218°
Heller Punkt (*a*) " 340°
" " (*b*) " 290°, Abstand $1^r.59 = 15''.5$
Nördlich vorausgehende Spitze des Fächers, Richtung 344°
Südlich folgende " " " 126°
Begränzung des Fächers:

in der Richtung	337°	Abstand	$4^r.06$	=	$39''.5$
" "	304	"	3.60	=	35.0
" "	253	"	3.01	=	29.3
" "	211	"	2.53	=	24.6
" "	192	"	2.75	=	26.8
" "	125	"	4.18	=	40.7

2. Am Halbbogen.

Aeussere Begränzung des Halbbogens:

in der Richtung	348°	Abstand	$7^r.81$	=	$76''.0$
" "	317	"	5.85	=	56.9
" "	279	"	5.32	=	51.8
" "	230	"	4.38	=	42.6
" "	199	"	4.50	=	43.7
" "	178	"	5.35	=	52.1
" "	119	"	8.54	=	83.1

"Bei den 4 Richtungen 230° - 119°, war die Begränzung viel weniger bestimmt als bei den vorhergehenden Richtungen, und besonders bei der letzten Richtung ist der angegebene Abstand nur als Schätzung anzusehn.

"Der südliche Nebeldunst hat sein Aussehn seit vorgestern nicht verändert.

"In 5 Minuten Abstand vom Kern wurde die ganze Breite des Schweifs auf 6′ geschätzt. Von diesen kommen 1′.5 auf den vorangehenden hellen Theil, 2′ auf den dunkleren Streif, und 2′.5 auf den nachfolgenden hellen Theil. Der dunklere Streif ist sehr unbestimmt begränzt und viel mehr mit Nebelmaterie gefüllt, wie früher, daher auch keine Messungen über seine Richtung angestellt werden konnten."

Poulkova. Winnecke. (*Pulk. Beob. des Grossen Cometen* 1858, p. 19.)

"Der Vergleichsstern 8^m wurde beim Eintreten in den hellen Schweifmantel um $20^h\ 45^m$ Sternz. fast unsichtbar, so dass die Vergleichungen nicht fortgesetzt werden konnten."

(Ibid., p. 21.)

"$D = 2''.79$. 3 Beob.

"Kern in heller Dämmerung rund und gut begränzt; mit der zweitstärksten Vergrösserung messe ich den Kern so, dass er bestimmt nicht zu klein gemessen wird. Herr Wagner fand später aus einer Einstellung, $D = 3''.18$. Als es dunkler wurde, kam es Herrn Wagner und mir vor, als sei der Kern elliptisch, die grosse Axe etwa senkrecht auf die Richtung des Schweifes; die Begränzung der Bilder war aber weit schlechter geworden."

(Ibid., pp. 26, 27.)

"$d = 29''.1$. 3 Beob.

"Positionswinkel. Kern, bis äusserste Spitze rechts 123°.6. 3 Beob.

" " " " links 346°.7. 3 "

"Der secundäre Kern verdient heute diesen Namen kaum; es ist vielmehr das äussere hellere Ende der jetzt noch mehr verdichteten Nebelmaterie, die den untern linken Rand des Sectors bildet und in den Fleck hinein pyramidenförmig sich zuspitzt. Abstand dieser Spitze vom Kerne $2\frac{1}{4}$ Kerndurchmesser. Unmittelbar am Kerne liegt ein nierenförmiges, helles Gebilde, das zum Theil den dunkeln Sector begränzt. Die Begränzung desselben ist überhaupt wulstförmig.

"Der dunkle Fleck hat sich vergrössert, so dass jetzt der kleinste Abstand zwischen den äussern Rändern von Fleck und innerm Sector nur einen Kerndurchmesser beträgt. Vom Kern geht ein hellerer Strahl aus, ungefähr in der Richtung zum Apex des Sectors.

"Aeusserer Sector. $d' = 39''.6$. 1 Beob.

"Die beiden Zonen desselben sind noch gleich breit. Die Verwaschenheit beider Sectoren nach dem Schweife hin hat zugenommen. Vor dem äussern Sector glaube ich heute den Schweifmantel noch zu erblicken, aber sehr schmal, nur wenige Secunden breit.

"Die äussere Hülle. Positionswinkel der Aufblähung 184°. 1 Beob.

"Abstand des äussern Randes vom Kerne in dieser Richtung 8'.5, senkrecht auf die Schweifaxe durch den Kern links 3'.5, rechts 9'.5."

(Ibid., p. 33.)

"$20^h\ 16^m$. $p = 60°.17$. 6 Beob.

"Die gleichmässige Färbung der Axe des Schweifes hat noch zugenommen."

1858. October 10. (Plates XLI. and XLIX. 99-103.)

There are indications of a dark opening in the new envelope, *E*, corresponding

in position with that which appeared upon *D*. Four envelopes are in sight, besides the external haze.

Göttingen. Auwers. (*Astron. Nachrichten*, 1167, p. 235.)

"Durchmesser des Kerns = 2″.21."

Observatory of Harvard College. G. P. Bond.

"The new envelope, *E*, sets much awry upon the axis of the tail, the lower edge being inclined to a line perpendicular to the axis, by an angle of 30°, estimated by the eye." This is probably too large, as the sketches give only 10° to 15° for this angle. The apparent right-hand side, as usual, is lowest. "There are bright rays in *E* (as represented on Plate XLI.). From near the vertex of *E* there seems to issue a little wisp or streamer, bent, as though driven back from the sun by an opposing blast. The envelope *D* has still convolutions with bright and dark places. Intrinsically, its whole surface is much less bright than that of *E*. The dark interval between *D* and *E* was not recognized, though I did not look expressly for it. *D* is rather the best defined on the preceding and upper side. The contrast between the light of the two branches of the tail is far less evident than it has been, and the parts near the axis are less dark. It is difficult to trace the dark stripe beyond 2′ or 3′ from the nucleus, and its abrupt termination there is far less marked than it was last evening. The new envelopes, when just projected, have so brilliant a surface, that with small telescopes they must be confounded with the true nucleus, and lead to erroneous determinations of the place of the comet, by making it appear to be nearer the sun than it really is. There are four envelopes in sight, besides the external haze. The nucleus is very small, 2″ or 3″ in diameter when best seen."

The following measurements were taken; the transverse diameters were measured with difficulty, on account of the divergence of the tangents at the points of intersection.

Transverse diameter of envelope			*E*,	in the direction	*e e″*	24″.7
"	"	"	*D*,	" "	*d d″*	84.3
"	"	"	*C*,	" "	*c c″*	133.3
Nucleus to *e′*, vertex of *E*,						11.0
"	*d′*,	"	*D*,			35.0
"	*c′*,	"	*C*,			56.3

The following positions of the opening in *E* have been read off from two sketches:

Angle of position of dark spot in E, ... $p + 194°$
" " " " . . . . . $p + 214°$
Distance from nucleus $8''.3$ and $6''.4$.

Bergantin de Guerra "Ancud." Lambayeque to Valparaiso. Costa and Gundian. (*Astron. Nachrichten*, 1182, p. 91.)

"El nucleo del cometa se pareció en cuanto a su brillo, a una estrella de primera magnitud."

Munich. Lamont. (*Jahresbericht der k. St. bei München*, p. 19.)

"Am 10 October, als ich den Kometen wieder beobachten konnte, hatte er die Gestalt Fig. . . (Plate XLIX. 101) angenommen. Das Aussehen des innern Kopfes war sich im Allgemeinen gleich geblieben; jedoch ging die Ausströmung, wie in dem Gerippe Fig. . . (Plate XLIX. 102) angedeutet ist, bei *d* weiter zurück als bei *e*. Im ersten Augenblicke hätte man glauben können, dass *c f* die Axe des innern Kopfes sei, und diese mit der Axe *c g* der äussern parabolischen Umhüllung einen Winkel mache: bei sorgfältiger Untersuchung habe ich aber die Ueberzeugung bekommen, dass *c f nicht* die Axe des Kopfes war, und dass nicht *f* sondern *h* den Scheitelpunkt der Parabel bildete.

"Hiernach besteht die Ursache der Unsymmetrie darin, dass auf der einen Seite des Kerns mehr Licht sich entwickelte als auf der andern."

Bergantin de Guerra "Ancud." Lambayeque to Valparaiso. Moesta. (*Astron. Nachrichten*, 1182, p. 91.)

"Der Kern war vollkommen so hell wie ein Stern 1 Grosse."

Altona. Pape. (*Astron. Nachrichten*, 1172, p. 318.)

"Die Betrachtung des Cometen im Fernrohr zeigte gegen die frühern Tage keine wesentliche Veränderung. Das Aussehen war verwaschener als früher. Der Radius des Ausströmungs-Sectors betrug um 7^h 10^m etwa $35''$, sein Umfang nicht über 180°.

"Der Winkel, welchen die Verlängerungen der Schweifäste mit einander bildeten, war grösser als in den frühern Tagen, so dass seit Ende Septbr. eine beständige Zunahme dieses Winkels stattgefunden hat.

"Seit Octbr. 6 sah ich dicht am Kern eine kleine innere sehr helle Ausströmung, die sich jeden Abend wieder zeigte. Ihre Helligkeit war kaum von der des Kerns zu unterscheiden, ihre Ausdehnung aber war so gering, dass ich über die Figur nichts Sicheres wahrnehmen konnte. Mir schien es nur, als ob sie an der linken Seite stärker war, als rechts. Heute Abend glaubte ich sie grösser zu sehen, als früher und vermuthete daher, dass diese Ausströmung der Anfang eines neuen in Entwickelung begriffenen Sectors sei. Jedoch kann ich aus meinen

Beobachtungen nichts Sicheres hierüber folgern. Die Messungen der Pos.-Winkel ergaben für

$6^h\ 20^m$ Sector $= 253^\circ.95$
Schweif $= 63^\circ.57$."

Observatory of Hamilton College, Clinton, N. Y. C. H. F. Peters. (*Mss.*)

"The general aspect of the comet not changed. A new inner corona has arisen, which is still small, and upon the left flank of which a black spot is visible in the same relative position as the spot on the previous corona. No spot discernible on the right flank. The outer corona is *open* to-day at the bottom; the curvature of its outline is not beyond a semicircle, and the remainder of this outline is clearly stretching out into, and mixing with, the brightest portion of the envelope of the tail."

Kremsmünster. Reslhuber. (*Astron. Nachrichten*, 1169, p. 264.)

"Kern merklich kleiner, vielleicht 9 Bog. Secunden im Durchmesser; ein neuer halbkreisförmiger Halo hat sich vom Kerne losgetrennt; die vorletzte Enveloppe, etwas matter, hat nun volle Parabelform; die drittletzte verlor sich in dem übrigen Kopfnebel. Komet scheint am Glanze etwas abgenommen zu haben, wenn nicht etwa der schwach umschleierte Himmel und die Dämmerung and der Schwächung Schuld tragen."

Vienna. Schmidt. (*Mss.*) (For explanation of the notation, see Oct. 4.)

"Ganz unsichere Beob. unter Wolken.

$7^h\ 41^m.0$ $r'?$ $= 26''.8$. 5 Beob."

Dessau. Schwabe. (*Astron. Nachrichten*, 1165, p. 208.)

"Mit 96 und 144m. V. erschien der doppelte Fächer zum erstenmal links (im a. F.) heller und besser begrenzt als rechts, hier aber stärker mit haarförmigen Streifen überdeckt. Der Schweif blieb fortwährend auf der convexen Seite heller, jedoch war der Unterschied mit der concaven geringer als früher. Die schattenartige Stelle am Kern, so wie die Lichtschwäche im mittleren Theile des Schweifes, zeigten sich weniger augenfällig als früher."

Albany. Searle. (*Astron. Journal*, No. 119.)

"Mr. Searle, at the Dudley Observatory, noticed not only that the nucleus was eccentric in reference to the coma, but also that the intense brilliancy from the nucleus extended about twice as far on the northern as on the southern side."

1858. October 11. (Plates XLII. and XLIX. 104-109.)

The dark opening between the branches of the tail is becoming filled with diffused light. The dark spot on the envelope E holds nearly the same relative

position with that which had previously been seen on *D*. The envelopes are now brightest on the preceding side; perhaps, also, that side of the tail near the head is brighter than the opposite branch.

OBSERVATORY OF HARVARD COLLEGE. G. P. BOND.

"Comet seen at times distinctly through thin clouds. The new envelope, *E*, is much larger than on the 10th. Its edge is but little less than half-way from the nucleus to the outer edge of *D*. The dark stripe to-night is scarcely discernible; this is possibly caused by the haze in the sky, but I think that a change has really occurred. The nucleus is well seen, 2″ in diameter, with two bright rays and a darkish spot above the preceding ray." The following measurements were taken, clouds preventing further observations:—

Transverse diameter of *E*, in the direction $e\,e''$	42″.1
" " *D*, " " $d\,d''$	103″.7

Measurements are made with difficulty.

From a sketch made at the time, the angle of position of the dark spot in *E*, was $p + 218°$, distance 13″.0. The same sketch gives for the distance from the nucleus to e', the vertex of *E*, 17″.7. Another drawing makes this distance 21″.3. A wisp or streamer apparently issues from the upper right-hand side of *E*, and bends towards the tail.

CAMBRIDGE, ENG. BREEN. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 17.)

"A sketch indicated two projections from the upper side of the nucleus, turned from the tail, and equally inclined to its axis. The attached envelope and the arch were nearly as before."

CAMBRIDGE, ENG. CHALLIS. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 19.)

"'Greater angular separation of the streams of the tail; the hood not so definitely bounded, the central brightness rounder, probably owing to the state of the atmosphere, the comet being low.' A sketch (Plate XLIX. 106) exhibited a determination of the head towards the left side, but the two streams of the tail of equal intensity."

HADDENHAM. DAWES. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 91.)

"The *interior sector* has greatly increased since the 8th. It is much *mottled*, the luminosity in different parts being far from uniform. To the southwest of the nucleus it has a very *dark* spot, rather pear-shaped, the smaller end being towards the centre; and also a *bright* spot nearly to the west of the nucleus, and only a few seconds from it, looking rather like a second, smaller and fainter nucleus. There is also a bright irregular streak, extending sunward from the nucleus to

COMET OF DONATI 1858.

OCTOBER 11TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE. PLATE XLII

G. P. Bond Del.

J. W. Watts Sc.

COMET OF DONATI 1858.

OCTOBER 15TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE. PLATE XLIII

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the arc of the inner sector. The middle radius of the sector is now inclined to the axis of the tail (reckoned round the *east* side as before) at an angle of about 205°, as deduced from my sketch." (Plate XLIX. 108.)

Liverpool. Hartnup. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 56.)

"Decided dark spots were seen in the coma near the nucleus; one on the 8th, and two on the 11th of October: . . . . .

Diameter of nucleus,	0′	23″
Diameter of first envelope,	1	54
Diameter of second envelope,	5	43
Distance from centre of nucleus to front of coma,	4	19
Diameter of coma at right angles to tail, measured through centre of nucleus,	10	39"

Leyden. Hoek. (*Astron. Nachrichten*, 1186, p. 159.)

"Am 11ten October gelang es mir, bei heiterem Himmel den Kern des Cometen und dessen Umgebung näher zu betrachten, und einige Data zu erhalten, welche vielleicht für die Kenntniss der physischen Beschaffenheit dieses Körpers ihren Werth haben. Der Kern war von zwei kreisförmigen Lichtsectoren umgeben, deren innerer der hellste war, und die einen Winkel von ungefähr 200° umfassten. Den Radius des inneren fand ich in zwei Richtungen, die um 90° verschieden waren 24″.1 und 23″.5 im Mittel 23″.8; den Radius des äusseren 51″.0 und 47″.5 im Mittel 49″.3. Der hellste Sector hatte einen Lichtstreifen, dessen Positionswinkel vom Kerne aus 48° 29′ war, von Norden nach Westen gezählt. Gerade am Kern war der Schweif getheilt von einem dunkelen Streifen, dessen Krümmung die Lichtsectoren begrenzte."

(Ibid., p. 160.)

"Dieser Streifen hat während der ersten Hälfte Octobers sehr auffallende Änderungen gezeigt. Anfangs war er schmal, doch ward er täglich breiter, und nahm bald den grössten Theil der Lichtsectoren ein. Folgende Zahlenwerthe werden dies hinlänglich darthun. Sie geben den Winkel, den an verschiedenen Tagen seine Tangenten gerade am Kern nach meinen Schätzungen einschlossen

am	4	Oct.	75°
	6	"	105
	9	"	120
	11	"	210
	16	"	270 "

Munich. Lamont. (*Jahresbericht der k. St. bei München*, p. 19.)

"Am 11 Oct. war die Unsymmetrie verschwunden und die Vertheilung des Lichts auf beiden Seiten gleich: irgend etwas Characteristisches konnte ich an diesem Tage sonst nicht bemerken."

Greenwich. Main. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 14.)

"The nucleus is still of a planetary character, and seems to be cut off on the under side by something like a phase of darkness. The inner disk now extends considerably below the bright point, and has decidedly assumed the parabolic character, throwing two small streams of light to a small distance, where they abruptly terminate. There is a dark curve passing through the extremities of this bright parabola and the central bright point, and going off into a parabolic form into the envelope, leaving a lune of light on each side. The outer bright parabolic annulus is not essentially different from that seen on Oct. 9. It first appeared well defined in the head; but later in the evening its definition was not so good, owing, perhaps, to a thin haze, indicating that its light is not strong. There is apparently a darkish band between the two parabolas of light. A peculiar feature in the comet's appearance this evening, is a decided ray that shoots upwards (apparently), or towards the head of the comet, making an angle of 45° with the axis of the envelope towards the apparent left, as seen inverted, and extending about the length of the semidiameter of the nucleus beyond it."

Main and Christy. (Ibid., p. 15.)

"Distance of bright point to outer edge of the inner disk (4 measures)
[in the direction of the axis of the envelope] . . . . . = 26″
Distance of bright point to outer edge of the outer annulus (2 measures)
[in the direction of the axis of the envelope] . . . . . = 42″
"Inclination of axis of the envelope to the meridian 71° to the east."

Kremsmünster. Reslhuber. (*Astron. Nachrichten*, 1169, p. 264.)

"Der jüngste Halo erweitert sich."

Vienna. Schmidt. (*Mss.*) (For notation, see Oct. 4.)

6ʰ 52ᵐ.7	$r' =$	25″.47	10 Beob.
6 59.1		28.01	10 "
7 28.2		33.87	10 "
6 51.7	$r'' =$	46.27 ?	10 Beob.
7 14.2		54.42	10 "

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 14.)

"Il giorno 11, si vede un cambiamento totale. E tutta arruffata, ed è mirabile, il cambiamento del nucleo interno. Il ventaglietto si è cambiato in un piccolo disco ben deciso, e a sinistra tiene una codetta lucida come vedesi nel disegno. (Plate XLIX. 107.) A destra vi è un altra codetta ma meno lucida. Il ventaglio grande con tutta la criniera sopra il nucleo pende dal lato Est apparente; verso la qual parte è rivolta la codetta più lucida. Sotto al nucleo la striscia oscura si è molto slargata ed è sfumatissima parimenti la coda si allarga moltissimo.

"La parte superiore del ventaglio secondo il solito è schiacciata da alcune sere in quà e la luce è diminuita di molto."

Oxford, Eng. Slatter. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 25.)

"*Nucleus* bright; diameter (estimated) 8″.

"*Envelope.* Another now visible, posterior edges open at about an angle of 150°. Parameter 45″ about, by measure."

Tretire. Webb. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 22.)

"It [the dusky streak] occupied perhaps $\frac{1}{4}$ [of the whole breadth of the tail] . . . . . . while it seemed to have become rather more filled up with nebulous light; the clear and broad notch which it cut out of the photosphere, even up to immediate contact with the back of the nucleus, increasing, of course, in breadth in a similar way. . . . . .

"When the comet had advanced beyond the range of the great telescope, the smaller one showed, though of course less evidently, a similar appearance; but the more luminous hemisphere now seemed to be inclined the other way, or partially to precede the nucleus in its course, its central radius making an angle of about 30° with the axis of the tail, as though there existed a kind of swinging motion, such as was perceived in the last return of the Comet of Halley."

1858. October 12. (Plate XLIX. 110, 111.)

Paris. Chacornac. (*Bulletin Obs. Imp. de Paris.*)

"Le 12 octobre, j'ai revu le même point noir dont la position par rapport à l'axe de la queue n'a pas sensiblement changé, mais il était plus large et moins sombre.

"La lumière inégale des sixième et septième enveloppes était fortement condensée dans le sens du rayon vecteur passant par le point noir; et chacune de ces enveloppes présentait, dans cette direction, une protubérance nettement accusée.

"La lumière du noyau de la Comète et celle des enveloppes avaient diminué d'éclat."

Markree. Graham. (*Obs. of Donati's Comet* 1858, *Markree*, p. 13.)

"The nucleus very nearly round, and better defined than on any former occasion. There is no appearance of that semi-elliptic blaze around it, unless it has expanded into what we shall still call the interior envelope; this extends beyond the semicircle or semi-ellipse, particularly on the W. side, where the cusp is lengthened downward in the direction of the tail. Supposing a radius drawn from the centre of the nucleus on the W. side, making an angle of 120° with the axis of

the tail, the portion of the interior envelope N. of this radius is not so bright as the rest.

"Mr. Cooper remarks that this envelope is flattened slightly on the S. side in the direction of a tangent, parallel to a line joining the cusps. The concave side of the envelope gives me again the impression of a caustic curve. The cometic matter could be traced beyond the second or fainter envelope."

Dorpat. Mädler. (*Beob. Kaiserl. Sternw. Dorpat*, XV. p. 49.)

"Eine Aufheiterung erfolgte nicht, aber die Wolken verdünnten sich. — Die Ausstrahlung bis 20^h scharf begrenzt; später verwaschen; der Kern heut nicht messbar.

Richtung der Ausstrahlung:		Halbmesser der Ausstrahlung:	
$19^h\ 25^m$	236° 9′	$19^h\ 35^m$	16″.000
19 51	236 13.3	19 48	16 .877
		20 0	17 .227

Richtung des Schweifes:

$19^h\ 54^m$ . . . 74° 15′."

Altona. Pape. (*Astron. Nachrichten*, 1172, p. 318.)

"Am 12ten heiterte es sich um 6^h auf. Das Aussehen des Cometen hatte sich erheblich geändert. Der Ausströmungs-Sector umfasste nur einen Bogen von 150° und dabei war der Radius nur etwa 15″. Seine Begrenzung am Scheitel war verwaschen und nach der linken Seite ging eine helle Ausstrahlung in den Schweif über. Die ganze linke Seite der Coma und des dem Kern zunächst gelegenen Schweifes war weit heller, als die rechte. Die Ausdehnung des Nebels auf der Sonnenseite mochte etwa 2′ – 3′ betragen.

"Die früher so scharf gegen diese Nebelumhüllung abgrenzte parabolische Zone hatte ihre scharfen Umrisse verloren. Die ganze Erscheinung hatte etwas sehr Nebelhaftes was sich vielleicht durch den tiefen Stand des Cometen erklärt.

"Ich erhielt die folgenden Messungen der Pos.-Winkel:

$6^h\ 20^m$ Sector = 239°.67

Schweif = 74°.00."

Madras. Powell. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 65.)

"Nucleus nearly but not quite as bright as on the 8th."

1858. October 13. (Plate XLIX. 112 – 116.)

Ann Arbor. Brünnow. (*Mss.*)

"Oct. 13. The appearance was very different. The nearest ring had disappeared; in the place of it was again a broad, fan-shaped jet ejected from the

nucleus with a projection in the angle of position 330°. There the distance of the rings from the nucleus was also the greatest."

Cambridge, Eng. Challis. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 19.)

"Comet scarcely to be seen for mist. I endeavored to estimate the radius of the exterior arch in the direction transverse to the axis of the tail. I think it was 6^r of the micrometer, or 52″. (This estimation is very uncertain.)"

Florence. Donati. (*Bulletin Obs. Imp. de Paris.*)

"Le 13, le noyau se montra mal défini. Son diamètre était de 5″. — On voyait une auréole ayant un rayon transversal de 11″.8."

Dorpat. Mädler. (*Beob. Kaiserl. Sternw. Dorpat*, XV. pp. 49, 50.)

"Heftiger Wind und viel Gewölk, so dass nur in einzelnen Pausen beobachtet werden konnte.

"An der kreisförmigen Ausstrahlung erschien das Licht nicht gleichförmig, doch konnten keine bestimmte Flecken bemerkt werden.

Richtung der Ausstrahlung:		Halbmesser:	
$19^h\ 2^m$ . .	237° 8′	$19^h\ 9^m$ . .	16″.228
		19 14 . . .	16 .416

Richtung des Schweifs $20^h\ 0^m$: 75° 40′ aus einer Einstellung."

Geneva. Plantamour. (*Note sur la Comète de Donati*, p. 8.)

"Le 13 octobre, à 5 heures 40 minutes du soir, dans le crépuscule, le fond du ciel étant assez clair, et par suite la comète assez pâle, ce qui rend difficile d'expliquer le fait par un effet de contraste, l'espace sombre derrière le noyau m'a semblé plutôt plus obscur que le fond du ciel. Cet espace sombre s'était considérablement étendu, de manière à entourer le noyau sur la moitié de sa surface, et à cacher la moitié de l'enveloppe circulaire intérieure; quelques mesures m'ont donné 11″.9 pour le diamètre du noyau, et 58″.2 pour celui de l'enveloppe circulaire. D'après ces mesures, le diamètre du noyau serait 0.38 et celui de l'enveloppe circulaire 1.87 fois celui de la terre."

Dessau. Schwabe. (*Astron. Nachrichten*, 1165, p. 208.)

"Oct. 13 hatte der Comet sehr bemerkbar abgenommen, jedoch konnte ich den doppelten Fächer noch deutlich erkennen und bemerken dass er links (im a. F.) heller war."

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 14.)

"Dalla fig. del 11 si vede che il nucleo non è più nel vertice del paraboloide della coda, ma che se ne scosta a destra. Questa eccentricità è più notabile nella fig. del 13 Ottobre (Plate XLIX. 114), e si vede una disposizione a quanto si presentò poi nella sera del 15."

Poulkova. O. Struve. (*Pulk. Beob. des Grossen Cometen* 1858, pp. 13, 14.)

"Der Kern hat seit der letzten Beobachtung sein Aussehn und Grösse nicht geändert, aber das Aussehn aller Theile am Kopfe des Cometen ist wesentlich verschieden. Besonders ist auffallend, dass die ganze Nebelmasse, um Kern und Fächer, bedeutend an Ausdehnung zugenommen hat. Vom Kerne ausgehend zeigen sich deutlich zwei Strahlen, die fast senkrecht zu einander stehn und den Fächer in drei Sectoren theilen, von denen der mittlere merklich helleren Glanz hat, als die beiden Seitenflügel. Die innere Begränzung des linken Seitenflügels ist sichtlich mehr gekrümmt, als die des rechten Flügels. Die äussere Begränzung des Halbbogens ist an beiden Seiten noch ziemlich deutlich zu erkennen, in der Mitte aber verschwimmt sie ganz mit der umgebenden Nebelmasse. Die Breite des dunkleren Zwischenraums zwischen Fächer und Halbbogen, wurde etwa auf die Hälfte der Breite des Halbbogens geschätzt, doch war auch dieser Zwischenraum theilweise mit Nebel gefüllt und daher weniger abstechend. Die Begränzung des helleren Halbbogens konnte auf beiden Seiten bis zu den vom Kern durch die Fächerspitzen gezogenen Richtungen verfolgt werden und verfloss weiter hin ganz mit den hellsten Schweiftheilen.

Messungen und Schätzungen.

$19^h\ 45^m — 20^h\ 20^m$

1. Am Kern und Fächer.

Durchmesser des Kerns 3″

Vorangehende Fächerspitze,	Richtung	19°,	Abstand	$3^r.05 = 29''.7$
Nachfolgende "	"	128°	"	$2^r.64 = 25''.7$
Richtung des nordöstlichen Strahls		307°		
" " südöstlichen "		212°		

Begränzung des Fächers:

in der Richtung des nordöstlichen Strahls $2^r.14 = 20''.8$

" " " südöstlichen " $1^r.62 = 15''.8$

"Der nordöstliche Strahl ist in seinem Beginn heller als der südöstliche, sein Licht fällt jedoch rasch ab, so dass er nur bis wenig über die Begränzung des Fächers hinausragt, während der andere noch durch den ganzen helleren Halbbogen hindurch verfolgt werden kann und sich erst in der äussern Nebelumhüllung verliert.

2. Am Halbbogen.

Aeussere Begränzung des Halbbogens:

in der Richtung	19°	Abstand	$6^r.17 = 60''.0$
" "	303	"	$4.48 = 43.6$
" "	213	"	$3.97 = 38.6$
" "	155	"	$4.95 = 48.2$

"In der Richtung der nachfolgenden Fächerspitze, oder bei 128°, konnte der Abstand des Halbbogens nicht mehr sicher gemessen werden, er schien etwas grösser zu sein als in der Richtung der vorangehenden Spitze.

"Bei der Richtung 336° oder 156° vom Kern aus, schätzte ich die Breite der ganzen Nebelmasse auf der vorangehenden Seite = 1.6 des Abstandes vom Kern bis zur äussern Begränzung des Halbbogens, auf der nachfolgenden Seite zu 2.5 Mal denselben Abstand. Hieraus ergiebt sich, da jener Abstand auf den beiden Seiten respective, nach den vorstehenden Messungen, zu 50″ und 48″ angenommen werden muss, für die angegebene Richtung die Ausdehnung des Cometen,

auf der vorangehenden Seite zu 80″
" nachfolgenden " 120″

"In dem Abstande von 3′ wurde die Breite des Cometen auf 6′ - 7′ geschätzt. Von diesen kommen beiläufig 1′ auf die dem Schweife vorangehende schwache Nebelmasse, 1′.5 auf den hellsten Theil der vorangehenden Schweifhälfte, 2′ auf den dunklen Zwischenraum und 2′.5 auf die nachfolgende Schweifhälfte."

Poulkova. Winnecke. (*Pulk. Beob. des Grossen Cometen* 1858, p. 21.)

"19^h 50^m Sternz. D = 3″.23. 2 Beob.

"Der Kern scheint der Erinnerung nach beiläufig dieselbe Grösse zu haben wie früher; seine Begränzung war für den tiefen Stand ganz erträglich."

(Ibid., p. 27.)

"19^h 50^m ± Sternz. Nach einem warmen, stürmischen Tage, heiterte es sich plötzlich von Nordwest auf; der Comet war schon gut mit blossem Auge zu sehen, als die Wolken ihn verliessen.

"Innerer Sector. *d* = 18″.4. 2 Beob.

Kern bis äusserste Spitze rechts 136°.5. 2 Beob.
" " " links 0°.1. 2 "

"Er verlief sich nach links (nördlich) in eine lange gebogene Spitze in den Schweif hinein; die Länge war wohl anderthalbmal so gross als der Scheitelradius des Sectors. Nach rechts ist die Begränzung nach dem Schweife zu ziemlich geradlinig. Das Loch im linken Theile des Sectors glaube ich noch zu erkennen, jedoch war es nicht mehr möglich völlige Gewissheit hierüber zu erlangen.

"Am Kern zeigte sich da, wo früher der nierenförmige Auswuchs gewesen war, eine längliche Verdichtung und der ganze Theil des Sectors in dieser Richtung *p* = 305°.2, 2 Beob., war heller als die andern Partien.

"Aeusserer Sector. *d′* = 34″.5. 2 Beob. schwierig.

"Dieser sowohl, wie der innere Sector, waren noch wohl begränzt; die hellere Zone des äussern Sectors war aber jetzt nur $\frac{2}{3}$ des Abstandes des äussern Randes vom innern Sector."

(Ibid., p. 33.)

"$20^h\ 1^m\ p = 82^\circ.13$. 5 Beob."

1858. October 14. (Plate XLIX. 117-121.)

Ann Arbor. Brünnow. (*Mss.*)

"On October 14 the comet was low when I observed it, and the atmosphere very bad. The upper part of the jet seen the preceding night had disappeared, while the one on the left-hand side was bent considerably more backwards."

Vienna. Hornstein and Weiss. (*Annalen der k. k. Sternw. Wien,* F. III. IX. p. 181.)

"Am 14 und 15 October erschien die ganze Nebelmasse in der Nähe des Kernes verwaschen. Die helleren und dunkleren Partien gingen allmälig in einander über; sowohl die fächerartige Ausströmung als auch der dunkle Theil des Schweifes zwischen den Aesten war sehr unbestimmt begrenzt. Dieser letztere Raum schien sich von Tag zu Tag mehr mit Lichtmaterie zu füllen, so dass er am 16 October selbst in der Nähe des Kernes von den helleren Schweifpartien nur wenig mehr unterschieden war. An letzterem Tage schien links von der Schweifaxe die grösste Helligkeit des Fächers. Bei stärkerer Vergrösserung zeigten sich in diesem Theile zwei helle Streifen oder Ausströmungen aus dem Kerne, die unter einem Winkel von etwa 30 Grader gegen einander geneigt waren. Der Fächer war weniger weit geöffnet als an den vorhergehenden Tagen, er umfasste einen Winkel von 215 bis 225 Graden am Kerne."

Munich. Lamont. (*Jahresbericht der k. St. bei München,* p. 19.)

"Die merkwürdigste Gestalt zeigte der Kopf am 14 Oct. Fig. . . (Plate XLIX. 118). Vom Kerne traten die zwei im Gerippe Fig. . . (Plate XLIX. 119) angezeigten Hauptströme *c d* und *c e* heraus, wovon der erstere stärker, der zweite etwas schwächer war: beide reichten bis zu der parabolischen Begrenzung. Ausserdem war besonders bemerklich die breite Strömung *c f g*, welche sich gegen die Spitze *g* verlor. Der Umriss der äussern Kopfhülle *h l k* war kaum wahrnehmbar."

Dorpat. Mädler. (*Beob. der Kaiserl. Sternw. Dorpat,* XV. p. 50.)

"Die Ausstrahlung ward zuerst gesehen $18^h\ 59^m$; und einige Minuten später war sie messbar. Das Licht derselben schien nicht ganz gleichförmig, namentlich im W. heller, allein bestimmte Gestalten waren bei dem tiefen Stande nicht mehr erkennbar.

Richtung	$19^h\ 3^m$ . .	$236^\circ\ 40'.7$	$19^h\ 11^m$ . .	$237^\circ\ 53'.5$
Halbmesser	19 17 .	$21''.351$	19 25 .	$21''.773$
Richtung des Schweifes	19 42 . .	$77^\circ\ 15'.3$		

"Vom Schweife erschien zuerst die um den Scheitel der Parabel herumliegende hellste Parthie $19^h\ 26^m$; 10 Minuten später auch das Uebrige."

Geneva. Plantamour. (*Note sur la Comète de Donati*, p. 9.)

"Le 14 octobre, l'apparence de la comète n'a pas changé notablement depuis la veille: à 5 heures 30 minutes du soir, le fond du ciel étant encore assez éclairé par le crépuscule pour que l'étoile de 7^e grandeur Weisse XV., 1150, qui a servi plus tard pour les comparaisons, ne fût pas encore visible, l'espace sombre derrière le noyau m'a paru plus obscur que le fond du ciel. Cette région obscure remontait encore plus que la veille des deux côtés du noyau, de façon que l'enveloppe circulaire n'était visible que sur une étendue notablement moindre que 180°. Les mesures ont donné pour le diamètre du noyau 11″.5 et pour celui de l'enveloppe circulaire 52″.0."

Vienna. Schmidt. (*Mss.*) (For notation, see Oct. 4.)

"5^h 58^m.5	$r =$ 31″.65	10 Beob.	
6 24.7	37.53	10 "	
6 49.3	42.42	10 "	

Abstand der kleinen Wolke v. Kern.

6^h 7^m.3	$\varrho =$ 19″.12	10 Beob."

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 14.)

"Il 14 la cometa avea il nucleo di 6″.4. La posizione della coda era 87°.0. Il raggio del ventaglio 39″.4. Sicchè il nucleo era molto cambiato di volume; assai deciso nella parte verso la coda e confuso dalla parte opposta."

1858. October 15. (Plates XLIII. and XLIX. 122-127.)

A new envelope of a remarkable form had appeared. This and the prevailing brightness on the left side of the head are the principal features of interest.

Observatory of Harvard College. G. P. Bond.

"A new envelope, *F*, has formed, or is forming; it lies altogether excentrically on the north side of the nucleus; outside of it is a darker space bordering it. Three envelopes are now visible, besides the external haze. The following measurements were made:—

Transverse diameter of *E*, in the direction *e e″*, ... 68″.9
Distance from the lower edge of nucleus to the vertex of *F*, in the direction of the axis of the tail, ... 13″.0
Angle of position of dark stripe, ... 90° 20′
" " longest diameter of *F* from the nucleus, $p +$ 276°

"The brightest part of the envelope is now decidedly on the north preceding side. The nucleus is very bright, and to the naked eye appears as a star of the 3d magnitude. The dark interval between *F* and *E*, and between *E* and *D*,

has, as usual, a decided filling in of light in the direction south preceding from the nucleus."

Cambridge, Eng. Breen. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 17.)

"According to the sketches, the near envelope was broader, and more depressed towards the tail on the left side than on the right side. The arch was marked at about the same distance from the nucleus as before. 'The comet had now much faded.'"

Paris. Chacornac. (*Bulletin Obs. Imp. de Paris.*)

"La huitième enveloppe est sortie du noyau. Hier elle avait une apparence de spirale bien marquée; son diamètre perpendiculaire à l'axe de la queue était de 23″.99 et le plus petit rayon vecteur 6″.99.

"L'excentricité a donc augmenté dans le sens que j'ai signalé dès le 8 octobre pour la 7ième enveloppe, au point d'être pour la huitième, supérieure au double du plus petit rayon vecteur. Le rayon vecteur parallèle à l'axe de la queue était de 11″.75."

Cambridge, Eng. Challis. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 20.)

"The length of the radius of the exterior arch in a direction inclined from its vertex by about 65° was found by measurement to be 4r of the micrometer, or 35″. 'The coma was distributed very unsymmetrically about the nucleus, being much more apparent on the lower, or northern side, than on the other. It was too faint on the latter side for measurement of the radius of the arch; there was a good deal of daylight. The boundary of the interior envelope was very definite; that of the exterior arch very indistinct and uncertain. The radius of the former on the apparent lower side was about one third that of the other, or 12″.' The nucleus and attached envelope presented in the sketch (Plate XLIX. 124) the form of an inverted comma. The interior boundaries of the two streams of the tail were confused, the comma spreading over the intermediate space. By measurement with a position-circle the axis of the tail was inclined northward from the equatorial direction by 4°."

Florence. Donati. (*Bulletin Obs. Imp. de Paris.*)

"Le 15, on ne voyait plus l'auréole du 13; mais le noyau paraissait entouré d'un hâlo. Le noyau perd de plus en plus de sa netteté, et avec les forts grossissements, ses bords disparaissent presque entièrement. Son diamètre est de 4″.5."

Christiania. Fearnley. (*Astron. Nachrichten*, 1242, p. 275.)

"Zuletzt habe ich am 15ten Oct. in heller Dämmerung und bei tiefem Stande nur einen [Enveloppen] gesehen (Rad. = 37″), welchen ich mit dem inneren vom 9ten Oct. für identisch halte."

Breslau. Galle. (*Astron. Nachrichten*, 1197, p. 41.)

"Der vom Kern ausgehende Fächer oder Büschel schien mit seiner Centrallinie nicht genau das Schweif-Conoid zu halbiren, sondern näher der Richtung des breiteren Zweiges (rechts im F.) sich anzuschliessen."

Greenwich. Main. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 14.)

"The outer parabolic disk much in the same state as on Oct. 11, but a considerable change has taken place with respect to the inner one. The nucleus is seen at the apparent right-hand extremity of the inner disk, which appears to be thrown off from it towards the left in a kind of jet. The shadow beneath the nucleus is not very strong. The envelope is seen to extend beyond the outer disk, excepting immediately at the extremity of the parabola."

(Ibid., p. 15.)

"Distance of bright point to outer edge of outer annulus (2 measures)
[in the direction of the axis of the envelope] . . . . . $= 34''$.
Inclination of axis of the envelope to the meridian . $= 90^\circ$ to the east."

Observatory of Hamilton College, Clinton, N. Y. C. H. F. Peters. (*Mss.*)

"There is only *one corona* this evening, extending over two thirds of the periphery, its right flank hanging down like a long sack. This portion is extremely dim, a bright ray, originating from the nucleus, and not directed exactly towards the apex, but deflected a little to the left, dividing it from the left flank. The latter shows a remarkable *indentation*, which below is bordered by a very bright ray, coming in a *spiral* form, almost like a horn, from the front of the nucleus. The *coma* is remarkably thin and narrow this evening. The tail shows a milky light, its envelope rather a uniform brightness. The *shadow* of the nucleus is very distinct, and is traced for more than half a degree without any effort; its deviation to the right from the axis of the tail is striking."

Geneva. Plantamour. (*Note sur la Comète de Donati*, p. 9.)

"Le 15 octobre, à 6 heures du soir, la région obscure derrière le noyau s'étend encore plus que le 14, mais elle présente d'un côté (à gauche en apparence dans la lunette astronomique) une entaille, comme si un rayon lumineux pénétrait dans cet espace sombre. Diamètre du noyau $10''.0$."

Vienna. Schmidt. (*Mss.*) (For the notation, see Oct. 4.)

$5^h\ 49^m.8$	$r' =$	$33''.18$	10 Beob.
6 8.3		39.90	10 "
6 33.2		40.61	10 "

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 14.)

"Le apparenze della sera del giorno 15 sono le più importanti di tutta l' appa-

rizione, perchè danno molto lume sulle osservazioni antiche. Comparve questa sera fornita di una specie di raggio a virgola come se uno dei due raggi che si vedeano prima si fosse torto a spira. Piccola da principio e molto aperta questa appendice spirale, si andò sempre ingrandendo e allungando fino ai 22 ottobre, in cui parea la sua punta quasi prossima a toccare il nucleo per richiudersi."

1858. October 16. (Plate XLIX. 128-130.)

CAMBRIDGE, ENG. CHALLIS. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 20.)

"The comet had nearly the same appearance as on the preceding evening; the comma form of the brightest part was seen in strong daylight; the boundary of the arch was still visible on the apparent lower side. By estimation from the teeth of the comb, its radius transverse to the axis was $4^r.7$ or $41''$. According to a drawing (Plate XLIX. 129) the radius of the brighter part was three sevenths of this measure, or about $18''$. The axis of the tail was nearly in the equatorial direction."

GREENWICH. CHRISTY. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 15.)

"The nucleus is in the same position as last evening, but appears less circular than hitherto. The peak, or vertex of the parabolic shadow, seems, — as far as the excessive faintness of the comet admits of correct observation, — to issue from the centre of the disk in which the nucleus is eccentrically situated. The outer parabola of light is ill defined. . . . . .

"Distance of bright point to outer edge of the inner disk (2 measures)
[in the direction of the axis of the envelope] . . . . $= 16''$.
Inclination of axis of the envelope to the meridian . $= 93°$ to the east."

FLORENCE. DONATI. (*Bulletin Obs. Imp. de Paris.*)

"Le 16 octobre, le noyau mal défini paraît entouré d'une atmosphère lumineuse, se terminant du côté ouest en une espèce de virgule. Vient ensuite une seconde auréole très-claire du côté ouest, et presque invisible à l'est. — Rayon longitudinal de cette auréole, $10''.25$. — Rayon transversal du côté ouest $18''.2$. — Le rayon transversal du côté est ne peut pas être mesuré par suite de l'incertitude du contour de l'auréole de ce côté-là."

MARKREE. GRAHAM. (*Obs. of Donati's Comet* 1858, *Markree*, p. 13.)

"We had the very low altitude of the comet, twilight, and moonlight, to contend with. The nucleus seemed to flare off obliquely to the line of the axis, to the W., and then to be twisted northward in a spiral, as if met by a current, or some repelling force, coming from the direction of the sun. The lopping off of the cusp of the coma on the eastern (or following) side of the nucleus was more marked than on former nights; this may have proceeded from the fainter light being obliterated by the strong moonlight. The succeeding envelope exhibited

nothing peculiar, except that it seemed thicker to the left, and was flattened in a line making an angle of 60°, to the right, with the axis of the tail. The flaring out of the light, and its sickle-shaped twist, were remarked by Mr. Cooper and myself independently. Mr. Cooper also observed that the tail seemed to diverge at a greater angle than on former nights; this he noticed first with an opera-glass, and found that the telescope confirmed his impression."

LEYDEN. HOEK. (*Astron. Nachrichten*, 1186, p. 160.)

"Am 16ten Oct. hatte der Lichtsector fast dieselbe Form, wie bei dem Halley'schen Cometen am 8ten Oct. 1835 nach *Bessel*. (*Astr. Nachr.* No. 300, 301, und 302.)"

MUNICH. LAMONT. (*Jahresbericht der. k. St. bei München*, p. 19.)

"Am 16 Oct. sah ich den Kometen nochmals; er hatte die Gestalt Fig. . . (Plate XLIX. 130.) Der schwächere Strom *c e* Fig. . . (Plate XLIX. 119) war verschwunden, den stärkern Strom *c d* konnte man bis gegen die parabolische Begrenzung hin verfolgen, obwohl er in grösserer Entfernung vom Kern fast verschwindend war. Der Raum *c f g* hatte sich nach allen Richtungen weiter ausgebreitet. Abgesehen von der verlängerten Strömung *f d* konnte man den Raum *c f g* und die rechts von *c f* befindliche Lichtmasse als einen neu sich entwickelnden *parabolischen Kopf* betrachten. Ich muss indessen bemerken dass erstens die genau parabolische Figur fehlte, ausserdem diese neue Parabel nicht ganz parallel mit der Begrenzung *d m e* des äussern Kopfes war. Unwahrscheinlich ist es mir aber keineswegs, dass zuletzt hier ein neuer Kopf sich nach und nach zu regelmässiger Gestalt ausgebildet haben mag, besonders desshalb, weil am 18 Oct., wo der Komet das Ansehen Fig. . . (Plate XLIX. 135) darbot, der Lichtbogen *f d* Fig. . . (Plate XLIX. 119) verschwunden war und die zunächst am Kerne befindliche Dunstmasse eine schärfere und der Parabel sich mehr annähernde Grenzlinie erhalten hatte. Man würde hiernach annehmen müssen, dass der Dunst in ungeformter Masse sich entwickelt und erst mit der Zeit die regelmässige Gestaltung zu Stande kommt."

ALTONA. PAPE. (*Astron. Nachrichten*, 1172, p. 319.)

"Der letzte Abend, an welchem ich den Cometen sah, war der des 16ten Octbr. $5^h\ 40^m$ war in heller Dämmerung nur der Kern und die Ausströmung sichtbar. Die Figur der Ausströmung war unregelmässig, die Begrenzung am Scheitel sehr verwaschen, der Winkel, welchen die Ränder am Kern einschlossen, betrug etwa 100°, der Scheitelradius vielleicht 15″ – 20″. Bei hereinbrechender Dunkelheit verhinderte der tiefe Stand des Cometen die genauere Betrachtung. Ich glaubte nur noch wahrzunehmen, dass die dunkle Zone zwischen den Schweifästen beinahe verschwunden war. Vier Einstellungen ergaben den Pos.-Winkel der Ausströmung um $5^h\ 40^m = 300°.15$."

(Ibid., 1173, p. 327.)

"Ich will hier gleich noch eine weitere auffallende Aehnlichkeit erwähnen, die bei der Figur der Ausströmung beider Cometen Statt fand und einer weitern Untersuchung werth ist. Zur Zeit der ersten Entwickelung der Ausströmung war dieselbe in der Richtung gegen den Scheitel der Coma verwaschen, der Anblick war der einer unmittelbaren Ausströmung vom Kern aus in die Coma und dann mit veränderter Richtung in den Schweif. So sah ich die Ausströmung noch Septbr. 22. Am 28 Septbr. hatte sich dagegen der scharf begrenzte Sector gebildet, den andere Astronomen schon einige Tage früher gesehen haben und den ich jedoch nicht mit gleicher Schärfe der Begrenzung, bis zum 12 Octbr. mit Sicherheit wahrgenommen habe. Die Vergleichung der Werthe des Halbmessers dieses Sectors an verschiedenen Tagen zeigt nun, dass vom 1 bis etwa zum 10 Octbr. eine beständige Zunahme derselben stattgefunden hat (die sich nicht durch die allmälige Annäherung des Cometen zur Erde allein erklärt) so dass der Halbmesser am 9 oder 10 Octbr. etwa doppelt so gross war als am 1 Octbr."

Madras. Powell. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 65.)

"Nucleus large and diffused; the convex or (now) southern side of envelope brighter than the other, the light in it appearing to diminish more abruptly, and so to form a greater contrast with the ground of the sky."

Vienna. Schmidt. (*Mss.*) (For the notation, see Oct. 4.)

$5^h\ 46^m.3$	$r' =$	$35''.06$	10 Beob.
6 14.1		40.40	10 "
6 35.0		41.64	10 "

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 15.)

"Il 16 ottobre il nucleo era di 5″.6; ed era assai eccentrico alla virgola spirale. Prendendo per maggior chiarezza le indicazioni dalla figura qui sotto si ebbero le seguenti misure alle ore 6. pom. Raggio *x y* dell' aureola cioè dal lembo del nucleo che resta più verso la coda fino al lembo della virgola opposto alla direzione della coda stessa 15″.00. Diametro *x b* cioè massima distanza della punta della virgola al lembo dell' altra parte 26″.12. Direzione *x b* suo angolo di posizione 352°.8."

1858. October 17. (Plate XLIX. 131-133.)

Haddenham. Dawes. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 91.)

"$6^h\ 18^m$. The comet is dim and hazy, but a marked peculiarity was immediately observed in the head. The nucleus is *very eccentric* (towards the *orbital* preceding side) with respect to the inner arch; and also, though not so strikingly,

with respect to the outer arch. The inner arch is much smaller than that seen on the 11th. Scarcely any tail is visible in the strong twilight and so near the horizon. A bank of clouds soon covered that part of the sky, and the weather did not subsequently permit the comet to be seen at all."

Neuchatel. Jeanjaquet. (*Souvenirs de la Comète de* 1858, p. 19.)

"Pris dans son ensemble, le noyau peut avoir encore autant d'éclat qu'une étoile de 3e grandeur. . . . . .

"Les bords, vu l'obscurité médiane, sont toujours la partie la plus éclairée de l'appendice."

Observatory of Hamilton College, Clinton, N. Y. C. H. F. Peters. (*Mss.*)

"Hazy sky. The spiral ray of Oct. 15 has now clearly expanded to form part of an inner corona; the indentation has been pressed farther off, remaining between the two coronas. The surface of the inner corona is brightest between the nucleus and apex; its flank to the right is very dim, and has only half the width of that to the left. The outline of the outer corona is very well defined, and shows the corona to have burst. It forms a semicircle, and continues in a tangential direction (especially to the left), joining with the tail. The tail appears pretty bright at the edges, and its breadth at the distance of 15 minutes from the nucleus is estimated to be 10 minutes. The nucleus appears rather well rounded, its shadow not visible, probably on account of the haze near the horizon."

Vienna. Schmidt. (*Mss.*) (For the notation, see Oct. 4.)

$5^h\ 50^m.5$	$r' =$	$16''.44$	10 Beob.
5 59.8		17.28	10 "
6 7.4		19.00	10 "

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 15.)

"Continua la figura spirale, è diminuito il nucleo, ed è cresciuta l' aureola.

Diametro del nucleo, ...	$= 5''.84$
Raggio $x\,y$ (di ieri), ...	$= 21.12$
Raggio $x\,b$, ...	$= 34.20$
Raggio $x\,a$, ...	$= 10.40$
Diametro $a\,b$, ...	$= 39.20$

"La coda della virgola è opposta a Venere.

Direzione $a\,b$, ...	$= 359°.38.$"

In the above notation, x represents the nucleus, y the vertex, a the right-hand edge of the spiral, and b its lowest point on the left.

1858. October 18. (Plate XLIX. 134-136.)

Observatory of Harvard College. G. P. Bond.

"The new envelope, *F*, of the 15th has extended itself to the right of the nucleus, and assumed more nearly the normal shape. Its outer boundary is well marked on the north preceding side, there being a comparatively dark interval just outside of it. Under good definition the nucleus appears quite small and pointed and is 3″ in diameter, with bright rays, especially one nearly towards the vertex of *F*. Three envelopes are seen besides the external haze.

"The left branch of the tail is decidedly the brighter. The dark stripe in the axis is scarcely to be distinguished."

The following measurements were made:

Breadth of the envelope *F*,	33″.2
Nucleus to *f′*, vertex of *F*,	14.8
Transverse diameter of *E*,	72.8
Nucleus to *e′*, vertex of *E*,	33.3
Angle of position of tail,	97° 35′

taken with difficulty through clouds.

A comparatively dark region or opening in *F* may be discerned in the angle of position $= p + 236° \ 0'$.

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 15.)

"Raggio *x y*,	= 23″.13
Diametro *a b*,	= 41″.74
Posizione *x b*,	= 4° 8′

"Le nubi impedirono le altre misure, ma la distanza del nucleo alla punta della virgola era maggiore di ieri sera. La figura (Plate XLIX. 136) questa sera è fedelissima e magnifica. Da alcuni giorni il ventaglio o alone grande che inviluppa la cometa e la virgola ha perduto molto della sua precisa terminazione, è molto sfumato ma sussiste."

1858. October 19. (Plates XLV. and XLIX. 137, 138.)

Observatory of Harvard College. G. P. Bond.

"The outline of the last-formed envelope, *F*, is much more regular than it has hitherto been, but it is still eccentrically placed; the vertex, however, is nearly in a line with the axis of the tail. There is a ray in it as indicated in the figure. (Plate XLV.) Outside of it the darkest part of the division between it and *E* is close to its northern edge. The outlines of both *E* and *F* are best seen on their north sides. No difference in the brightness of the two sides of the tail is noticeable. The nucleus is brighter, as if preparing for throwing off another envelope. It was

COMET OF DONATI 1858.

OCTOBER 18TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE. PLATE XLIV

G. P. Bond Del.

J. W. Watts Sc.

COMET OF DONATI 1858.

OCTOBER 19TH & 20TH 7H M.S.T. OBSERVATORY OF HARVARD COLLEGE. PLATE XLV-XLVI

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found to be far brighter than the stars B. A. C. 5633, 5709, or 5711, which were compared with it at the same altitude. It must be of the 5th magnitude, excluding the envelopes. To the naked eye it is equal to a star of the 3d magnitude.

"In the finder the tail looks much more compressed towards the axis than usual, being only 6′ wide at 50′ from the nucleus, the outlines being nearly parallel at 15′. In the great refractor, its breadth at 12′ from the nucleus is 5′."

The following measurements were taken: —

Nucleus to *f′*, vertex of *F*, ... 17″.9
" *e′*, " *E*, ... 36.4

The outline at *e′* is very faint.

Longest transverse diameter of *F*, in a direction inclined 70° to the axis of the tail, ... = 42.0

Of this, about 28″ is the distance of the nucleus from the north following side of *F*, and the remainder, viz. 14″, its distance from the north preceding side.

Diameter of the nucleus, ... 3.0
Angle of position of the tail, ... 102° 35′

Florence. Donati. (*Bulletin Obs. Imp. de Paris.*)

"D'après l'ensemble de toutes ces observations, je crois qu'on ne saurait mettre en doute que le soleil n'ait successivement détaché de la matière de la tête de la Comète, laquelle matière s'est ensuite dispersée en allant constituer la chevelure et la queue."

(Ibid.)

"M. le Prof. Govi, qui a observé, lui aussi, la Comète depuis le 27 septembre, et qui a adressé ses observations à M. Babinet, a constaté d'abord la polarisation de la lumière cométaire, en confirmation de ce qu'avait vu Arago en 1835 sur la Comète de Halley; puis il a determiné la position du plan de polarisation de cette lumière, dont la trace coïncidait sensiblement avec l'axe de la queue. Cette coïncidence s'est maintenue jusqu'au 16 octobre, jour après lequel la Comète n'a plus été observée à cause du mauvais temps. Cette position du plan de polarisation, rapportée à la position du soleil, ne laisse plus aucun doute sur la provenance de la partie la plus considérable de la lumière de la Comète."

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 15.)

"La coda della virgola è cresciuta e pare che si pieghi da una parte, cioè verso Est appar. Il ventaglio o nimbo grande è sparito o per meglio dire si confonde colla chioma. L' aria era così squisita questa sera che si pote osservare la luna presso l' orizzonte coll' ingrandimento 1500, e distinguervi le strie

dei crateri. Quindi il disegno (Plate XLIX. 138) merita fede. Nelle seguenti sere fino ai 22 non si presero misure ma solo i disegni. Si osservò in queste ultime sere un colore più rossastro di prima che divenne assai pronunciato quando la cometa giunse presso Venere."

1858. October 20. (Plates XLVI. and XLIX. 139.)

Observatory of Harvard College. G. P. Bond.

"I have little doubt that a new envelope, *G*, is forming, as on the 15th, by a projection from the north side of the nucleus, but the comet is so near the horizon that it is difficult to observe. The brightest part of the head of the comet is on the preceding side of a line in the angle of position 10° 5′.

"It is decidedly brightest on the north side. The transverse diameter of *F*, in the angle of position 37°, to which the outline may be traced with pretty decided light, is 100″."

1858. October 21.

Rio de Janeiro. Liais. (*Comptes Rendus*, Vol. XLVIII. p. 625.)

"A partir du 21 octobre la comète a presenté une uniformité très grande dans l'intensité de la lumière de sa queue, qui s'affaiblissait seulement sur les bords; cette queue et la nebulosité formaient par leur ensemble une sorte de paraboloïde sans qu'on distinguât aucune limite entre ces deux parties de la comète. Le noyau n'avait pas un aspect planétaire et s'éloignait de plus en plus de cet aspect à mesure qu'on forçait le grossissement. . . . . .

"Le 21 octobre le noyau de la comète a paru dans le crépuscule, en même temps que les étoiles de la queue du Scorpion."

1858. October 22. (Plate XLIX. 140.)

Collegio Romano. Secchi. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 15.)

"Mancano le misure, ma la coda della virgola pare ripiegarsi per venire a ritrovare il nucleo."

1858. October 23. (Plate XLIX. 141.)

The following description shows that the envelope *G*, suspected on the 20th, was now unmistakably developed in a form quite similar to that of *F* and several others at earlier dates.

Cape of Good Hope. Maclear. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 72.)

"The comet's head when viewed with the ordinary observing power (126) appears to consist of two concentric luminous envelopes nearly surrounding the nucleus on the side next the sun. The nucleus, which is a bright disk 4″ in diameter, is situated at the apex of a sector of less intense light of somewhat

this form. (Plate XLIX. 141.) The sector and envelopes are separated from each other by tolerably clearly marked dark bands. The exterior envelope is fainter and traced with less distinctness than the interior envelope, and its light soon becomes blended with the general nebulosity of the head.

"A few measures of the head were taken this evening, but they are not very accurate, as the 'Flat-wire' micrometer is not well adapted for the purpose.

Distance of nucleus from the vertex of the head of comet, .	156″
Breadth of head through the nucleus, ...	165
Nucleus to vertex of sector, ...	15
Breadth of sector, ...	23."

1858. October 25.

BERGANTIN DE GUERRA "ANCUD." LAMBAYEQUE TO VALPARAISO. COSTA AND GUNDIAN. (*Astron. Nachrichten*, 1182, p. 93.)

"El núcleo del cometa se presentaba con el esplendor de una estrella de tercera magnitud; la cola mas brillante que la parte adyacente de la vialactea."

CAPE OF GOOD HOPE. MACLEAR. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 72.)

"Diameter of nucleus 4″.5."

1858. October 26.

MADRAS. POWELL. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 65.)

"Envelope evident, but very faint; nucleus large, ragged, and indistinct."

1858. October 27.

MADRAS. POWELL. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 65.)

"Comet very faint; nucleus large and hazy."

1858. October 29.

CAPE OF GOOD HOPE. MACLEAR. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 72.)

"The sector of light described on the 23d can now no longer be traced. The comet's head has the appearance of a nebulosity of parabolic outline, having at its focus a somewhat bright condensation of light about 10″ in diameter, enveloping the nucleus. Breadth of head at the nucleus = 203″. Nucleus to vertex = 151″."

1858. October 30.

CAPE OF GOOD HOPE. MACLEAR. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 73.)

"Diameter of nucleus = 4″.4."

1858. October 31.

CAPE OF GOOD HOPE. MACLEAR. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 73.)

"Diameter of nucleus = 3″.9. Breadth of head at nucleus = 153″."

1858. November 5.

Cape of Good Hope. Maclear. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 73.)

"Breadth of head at nucleus = 171″. Nucleus to vertex = 100″."

1858. December 4.

Rio de Janeiro. Liais. (*Comptes Rendus*, Vol. XLVIII. p. 626.)

"Le 4 décembre ce noyau paraissait égal en intensité à deux petites étoiles de 6^e^, 7^e^ grandeur qu'on voyait à travers la nebulosité de la queue et qui paraissaient un peu etalées."

The Comet was last seen with the naked eye as follows:—

1858. Nov. 8. Frigate Novarra. Wüllerstorf. (*Astron. Nachrichten*, 1190, p. 218.)
" " 12. Williamstown, Australia. Ellery. (*Mss.*)
" " 14. Brelum. Lat. + 11° 55′. Long. 104° 50′ E. Arnoux. (*Comptes Rendus*, Vol. XLVIII. p. 852.)
" Dec. 4. Santiago. Moesta. (*Astron. Nachrichten*, 1257, p. 131.)
" " 9. Rio de Janeiro. Liais. (*Comptes Rendus*, Vol. XLVIII. p. 112.)

1858. December 10.

Rio de Janeiro. Liais. (*Comptes Rendus*, Vol. XLVIII. p. 625.)

"Cette queue a disparu du 3 au 6 de ce dernier mois, la comète ayant pris une forme spherique avec le noyau un peu excentrique et placé du côté du soleil. Une petite queue conique parut vouloir se reformer le 8 décembre et avait disparu le 10. Le noyau était alors plus diffus et paraissait présenter moins de condensation à son centre. C'est à cette époque que la comète a cessé d'être visible à l'œil nu. La nébulosité de la comète augmentait de diamètre à mesure que, laissant le grossissement constant, on augmentait l'ouverture de la lunette."

1858. December 23.

Cape of Good Hope. Maclear. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 73.)

"The comet is now merely a faint nebulous body, about 90″ in diameter, with a slight central condensation of light. No trace of a tail."

1858. December 30.

Cape of Good Hope. Maclear. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 73.)

"The diameter of the comet is 98″."

1859. January 23.

Rio de Janeiro. Liais. (*Comptes Rendus*, Vol. XLVIII. p. 626.)

"J'ai vu la comète pour la dernière fois le 23 janvier. Elle soustendait un angle de 4 à 5 minutes, et ne présentait plus de condensation bien appréciable à son centre. Sa faiblesse ne me permettait plus de l'observer au théodolite."

1859. January 24.

CAPE OF GOOD HOPE. MACLEAR. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 73.)

"Diameter of comet about 60″."

1859. February 26.

CAPE OF GOOD HOPE. MACLEAR. (*Memoirs Royal Astr. Soc.*, Vol. XXIX. p. 73.)

"Diameter of comet = 54″."

There remain a few extracts which could not be conveniently arranged with the other notices under particular dates. They will be introduced here under three divisions, viz.: — 1. Those of a miscellaneous character, relating principally to the telescopic aspect of the Comet. 2. Observations on the brightness of the head or nucleus. 3. Observations on the polarization of the light of the Comet.

Additional Observations on the Telescopic Aspect of the Comet.

CAMBRIDGE, ENG. CHALLIS. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 20.)

"In the course of the observations my attention was especially directed to the following particulars, respecting which I can speak with confidence. The brightness contiguous to the nucleus preponderated on the right side (as seen in the telescope) till October 2; and on October 9 the excess had passed to the left side. The excess of brightness of the right-hand stream of the tail above that of the other attained its maximum about October 2; after which there was a gradual diminution, till, on October 11, 15, and 16, the two streams were not sensibly unequal. The dark band separating the two portions of the tail was of uniform width and definite boundary on September 30 and October 2; and in proportion as the boundaries afterwards became indefinite, and the intervening space was gradually filled with luminosity, the angular divergence of the two streams also increased."

HADDENHAM. DAWES. (*Mss.*)

"I always judged the *apex of the tail* to fall *within* the circular outline of the *largest of the luminous sectors;* beyond which the *diffused nebulosity* extended considerably farther."

WILLIAMSTOWN, VICTORIA. ELLERY. (*Mss.*)

"1. The extent of nebulosity in the direction of the sun was always small, — it became somewhat more diffused towards the latter part of its appearance.

"2. The nucleus to the last appeared decidedly concentrated. The last time I observed it (barely visible with a power of 120 on a $4\frac{1}{2}$ objective) the nucleus was well defined.

"3. The angle of divergence of the two margins of the tail varied from about 4° to 7° or 8°.

"4. . . . . . The brightest side of the tail was always that presented to the S. E."

GENEVA. PLANTAMOUR. (*Note sur la Comète de Donati*, p. 9.)

"Parmi les phénomènes curieux qu'a présentés l'apparence de la comète de Donati, celui qui m'a frappé le plus, c'est l'espace obscur placé derrière le noyau dans la partie opposée au soleil, phénomène que l'on reconnaît également dans les dessins de la comète de Halley publiés par Bessel. Cet espace obscur a varié considérablement d'un jour à l'autre, dans sa forme et dans son étendue, ainsi que le montrent les dessins ci-joints; tandis qu'au commencement d'octobre il se présentait sous la forme d'une bande parabolique étroite, touchant à peine le noyau par son sommet; il s'est graduellement étendu, de façon à envelopper le noyau sur plus de la moitié de sa surface. Il en résulte un changement dans l'apparence de l'enveloppe lumineuse qui entoure immédiatement le noyau, et qui forme la partie la plus brillante de la tête, cette enveloppe étant limitée par l'espace obscur. Ainsi, au mois de septembre, cette enveloppe lumineuse avait la forme d'un secteur comprenant un angle de plus de 90° et de moins de 180° (130° environ le 26), mais l'espace obscur était moins sombre qu'il ne l'a été plus tard, au mois d'octobre. Le 3 octobre, le secteur lumineux comprenait un angle de 330° environ, puis son ouverture a diminué graduellement, de façon à n'être plus que de 150° le 15 octobre."

COLLEGIO ROMANO. SECCHI. (*Mem. dell' Osserv. del Coll. Romano*, 1859, p. 15.)

"Dagli elementi dell' orbita confrontati colle epoche delle osservazioni precedenti risulta, — 1°. Che l' ingrandimento osservato negli ultimi giorni dell' aureola o virgola, è un ingrandimento reale perchè dal 16 al 22 Ottobre la cometa si andò sempre allontanando da noi, e dal Sole, laonde crescendo le distanze avrebbe dovuto diminuire il suo volume apparente. Anche il diametro di questa cometa come di molte altre è dunque andato crescendo coll' allontanarsi dal Sole. 2°. Che le prime distorsioni si manifestarono nell' avvicinarsi della Cometa alla terra, cioè agli 8, e che agli 11 Ottobre, che fu il giorno della massima vicinanza alla terra, si ebbero delle apparenze di getti lucidi analoghi a quelli che in essa si produssero da principio nell' avvicinarsi al Sole. 3°. Che lo sviluppo dell' aureola

a forma di virgola combina coll' epoca della prossimità della Cometa a Venere, e che la direzione della coda della virgola era opposta a questo pianeta.

"È degno di osservazione che questa ultima apparenza a foggia di virgola fu mostrata anche dalla Cometa di Halley nel 1682, la cui figura ci è stata conservata da Evelio e riportata da Smith nel Vol. IX. delle Memorie della Società Astronomica, 1836, p. 239. Questi osservò getti di luce il 10 Ottobre in quella Cometa ed è pure singolare che la produzione di tali getti combina colla massima vicinanza della Cometa alla terra in quell' epoca.

"Queste coincidenze sono importantissime e le ha notate il p. Rosa mio collega, e non è improbabile che come la vicinanza del Sole produce tanti cambiamenti nelle Comete, non ne possa produrre qualcheduno anche la vicinanza de' primari pianeti. Pare che il massimo sviluppo della virgola avesse luogo nella minima distanza da Venere e che la virgola mostrò tendenza a richiudersi quando se ne allontanò. La Cometa essendo certamente un solido a tre dimensioni, e noi non ne vedendo che la prolezione sul piano perpendicolare al raggio visuale potrebbe essere che molte mutazioni fossero meramente apparenti; la forma spirale però dell' aureola nel caso nostro risulta reale, e ciò si prova anche dalla forte luce che avea questo getto dalla parte convessa mentre andava svanendo dall' altra. Cosi pure si è riconosciuto esser reale la curvatura della coda, e l' eccentricità del nucleo."

Tretire. Webb. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 23.)

"The two streams which formed the tail were for a long time unequal in breadth, but were never observed to change sides so as to indicate rotation; the antecedent branch showed greater fulness and density near its origin, even with the small object-glass, on Sept. 24. With the large one on Sept. 30, it was estimated the broader in the ratio of about 4 to 3; on Oct. 4 and 5, as 3 to 2. Oct. 11, they appeared with the small telescope of equal breadth. During the whole time the angle at which they came off from the nucleus underwent a steady increase; the antecedent stream was always far better defined than the other at its exterior edge. These two streams were connected round the sunny side of the envelope or photosphere by a border of the same material, much narrower and fainter than the envelope. This border, which formed the vertex of the tail considered as a paraboloid, was, on Oct. 4 and 5, suspected to be bounded by a delicately brightened up semicircular edging, as though it were merely a thin shell; but this remained questionable. Beyond this border a considerable extent of very faint haze was visible, melting gradually into the clear sky."

Additional Observations relating to the Brightness of the Comet.

Berlin. Bruhns. (*Astron. Nachrichten*, 1205, pp. 69, 70.)

"Was die Helligkeit anbetrifft, so haben wir bis jetzt noch gar keine Mittel, sie eigentlich ordentlich zu bestimmen, das Cometenlicht mit Fixsternen zu vergleichen ist wegen der Verschiedenheit ihres Lichtes nicht gut möglich, besonders deswegen nicht, weil die Fixsterne leuchtende Puncte, die Cometen aber nebelartige Scheiben sind. Eher ist eine Vergleichung zwischen Planetenscheiben und Cometen möglich, und besonders dann, wenn der Comet einen scheibenartigen Kern hat, Planeten sind aber nicht immer über dem Horizonte, und ausserdem oft an einer ganz andern Stelle des Himmels, so dass, wenn man nicht Photometervorrichtungen hat, um beide Körper gleichzeitig im Felde zu sehen, der Eindruck des einen Körpers auf das Auge schon wieder verschwunden ist, wenn man ihn von dem andern Körper bekömmt.

"Ich habe oft den Eindruck, den das Cometenlicht auf das Auge machte, verglichen mit dem, den ein Fixstern auf das Auge hervorbrachte und mir darüber einiges aufnotirt, ich gebe es hier, wie ich es niedergeschrieben, bemerke aber ausdrücklich, dass man es nicht als photometrische Resultate betrachten darf. . . . . .

"Um Mitte des Juni, er stand damals am nordwestlichen Horizonte, in der hellen Dämmerung und Sterne 11ter Grösse in seiner Nähe konnte man am Refractor ebenso, wie ihn, nur mit Anstrengung erkennen. . . . . .

"Am 28sten Aug. sah ich ihn zuerst mit blossem Auge, er stand nicht allzu hoch und Sterne 5ter – 6ter Grösse in seiner Nähe konnte ich eben erkennen. Seine Helligkeit nahm rasch zu, die des Kopfes machte auf das blosse Auge,

Sept. 2. um	8^h	denselben Eindruck,	als ein	Stern	3 – 4	Grösse,
6. um	14.5	"	"	"	3	"
15. um	7.4	"	"	"	α Ursæ Maj.;	

an diesem Tage um $7^h.5$, also 49^m nach Sonnenuntergang, sah ich ihn mit blossem Auge und Sept. 16 um $14^h.4$ schien es, als wenn der Eindruck auf das blosse Auge etwas geringer sei, als der von α Leonis.

"Von dieser Zeit an versuchte ich oft, ihn am Tage, sowohl mit dem Refractor, als mit dem Meridiankreise zu sehen, ich hatte am Meridiankreise alle möglichen Vorkehrungen und Vorsichtsmassregeln getroffen, um ihn in der obern Culmination zu beobachten, nie ist mir dies gelungen, und in dem 4 Zoll. Oeffnung haltenden Fernrohr des Meridiankreises habe ich nie eine Spur weder mit 50 —, noch 80 —, noch 120 facher Vergrösserung sehen können.

"Als er gegen Ende September hier noch am Morgenhimmel sichtbar war, verfolgte ich ihn einige Mal mit dem Refractor, indem ich das Uhrwerk gehen liess und ihn in Folge dessen fast immer genau in der Mitte des Feldes hatte, er verschwand immer schon vor Aufgang der Sonne, und ihn am Morgenhimmel am Tage, d. h. nach Sonnenaufgang zu sehen, ist auch nicht möglich gewesen.

"Anfang October stellte ich den Refractor Nachmittags bereits auf ihn ein, nie habe ich ihn früher, als etwa eine halbe Stunde *vor* Sonnenuntergang sehen können, dann erschien er als ein so schwacher Nebel, dass man die Unmöglichkeit, ihn früher zu sehen, einsah. . . . . .

"Sept. 30 bei nicht ganz reiner Luft, konnte ich ihn erst am 5^h 45^m, also 5^m nach Sonnenuntergang im Refractor sehen, mit blossem Auge erst um 6^h 15^m.

"Oct. 4 fand ich ihn um 5^h 9^m, also noch 22^m vor Sonnenuntergang mit dem Refractor mit 90 facher Vergrösserung, um 5^h 30^m sah ich in seiner Nähe einen Stern 6^{ter} Grösse, um 6^h fand ich ihn augenblicklich mit blossem Auge.

"Oct. 5 war der Comet gleich, als ich ihn um 5^h 25^m einstellte, sichtbar, um 5^h 35^m zeigte sich schon die Ausstrahlung (der innere Sector), es wurde bald nachher trübe, so dass die Bedeckung des Arcturus durch den Schweif nicht gesehen werden konnte.

"Oct. 8 sah ich den Cometen, obgleich der Himmel mit dünnen Wolken bedeckt war, im Refractor um 5^h 0^m, also 22^m vor Sonnenuntergang.

"Oct. 15 zeigte er sich bei tiefem Stande erst um 5^h 15^m als sehr schwaches Object.

"Oct. 16 sah ich den Cometen, als ich um 5^h 20^m den Refractor auf ihn einstellte, sofort, um dieselbe Zeit wurde auch ein Stern 7^{ter} Grösse in seiner Nähe sichtbar, um die Vergleichsterne 9^{ter} Grösse zu sehen, musste ich noch 30^m warten. Als ich ihn mit blossem Auge sah, schien der Kopf auf das Auge keinen grössern Eindruck zu machen, als Sterne 2^{ter} – 3^{ter} Grösse in derselben Höhe.

"Oct. 19 sah ich ihn zuletzt, er stand so nahe dem Horizont, dass keine Beobachtungen mehr möglich waren, Sterne 7^{ter} und 8^{ter} Grösse waren in seiner Nähe nicht sichtbar."

Rio de Janeiro. Liais. (*Comptes Rendus,* Vol. XLVIII. p. 626.)

"L'intensité de la nebulosité cométaire près du noyau a été comparée à celle de la grande nuée magellanique en plaçant le noyau hors du champ, mais près du bord, et faisant varier le grossissement et l'ouverture de manière à obtenir l'égalité des deux lueurs. J'ai ainsi trouvé que le 24 octobre cette lumière était 11 fois plus grande que celle de cette nuée; le 3 décembre elle était 5.5 fois moins brillante, et le 6 décembre 7 fois moins lumineuse que cette nuée."

VIENNA. SCHMIDT. (*Mss.*)

"Erste Sichtbarkeit des Cometen in der Dämmerung mit freiem Auge.

1858.	Sept. 12	Comet	sichtbar	39	Min.	nach	⊙	Untergang.
	22	"	"	26	"	"	"	"
	30	"	"	22	"	"	"	"
	Oct. 7	"	"	20	"	"	"	"
	14	"	"	32	"	"	"	"
	18	"	"	44	"	"	"	"

Sichtbarkeit des Cometen am Tage.

"Aehnlich wie bei Klinkerfües Cometen 1853, den ich in Olmutz 7 Tage lang neben der Sonne beobachtete, suchte ich auch Donati's Cometen am Tage auf; von 1858 Sept. 23 bis Oct. 3 konnte ich ihn nur etliche Minuten *nach*, aber October 4 und 5 sicher 12 und 13 Minuten *vor* dem Untergange der ⊙ am Fernrohre erkennen.

Glanz des Cometen.

"October 6 – 8 war für das blosse Auge das Maximum der Helligkeit des Kopfes; der Comet übertraf ein Weniges das Licht von Arcturus."

MUNICH. SEIDEL. (*Astron. Nachrichten*, 1193, p. 261.)

"Im Herbste des letzten Jahres, vom 28 Sept. bis 10 Octbr., benutzte ich das *Steinheil'sche* Objectif-Photometer zu verschiedenen Messungen am grossen Cometen. Wiewohl dieselben noch nicht berechnet sind, erlaube ich mir doch, eine vorläufige Notiz darüber zu geben. Meine Messungen waren dreifacher Art: einerseits wurde der helle Kern in derselben Weise, wie ein Stern observirt, andrerseits wurde die Helligkeit des Kopfes und verschiedener Stellen des Schweifes, nahe dem Kopfe, dadurch gemessen, dass ich dieselbe, im Bilde betrachtet, derjenigen des Phantoms gleich zu machen suchte, welches ich von einem Fixstern durch Longitudinalverschiebung der ihn zeigenden Objectivhälfte erhielt, doch konnte auf diese Art die vom Kopf aus abnehmende Helligkeit des Schweifs nur einige Grade weit verfolgt werden, weil sie in etwas grösserer Entfernung schon zu gering war, um im Photometerrohr von derjenigen des Himmelsgrundes noch ordentlich loszugehn. Endlich habe ich zweimal Paare von Fixsternen unter einander verglichen, wenn der eine Stern im Schweif, der andere frei daneben stand; mit der Absicht, dieselben Paare zu andern Zeit wieder zu vergleichen. Leider bin ich bei den letzten Messungen, auf die ich erst etwas spät verfiel, vom Wetter wenig begünstigt worden. An dem Tage wo der Comet vor Arcturus vorbeiging, waren hier beide nur auf Augenblicke sichtbar. Die Farbe des Schweifs ist mir (mit blossem Auge gesehen) immer deutlich bläulich-aschfarb vorgekom-

men, namentlich auch dann, wenn ich sie mit derjenigen der Milchstrasse verglich, die mir dagegen röthlich erschien. Der Kern schien mir entschieden gelblich, welche Färbung mir zum erstenmal am 7 Octbr. bei der Betrachtung durch einen Tubus von 27 Lin. Oeffnung von *Merz*, und zwar mit allen drei Ocularen desselben auffiel; die denselben überwölbende Coma kam mir gleichzeitig trüb orange vor; bei Sternen konnte ich durch dasselbe Instrument keine ähnliche Färbung bemerken. Auch noch am 14 Octbr. schien mir mit blossem Auge der Kopf gelblich, während jedoch die blaue Farbe des Himmelsgrundes noch deutlich wahrnehmbar war. An diesem Abend wurde der Comet anfangs in wölkiger Trübung, später derselben sehr nahe gesehen, dabei sah ich an ihm einen Lichtwechsel (am Kern) welcher dem Funkeln der Sterne sehr ähnlich war, so dass ich ihn auf Augenblicke für ganz entschieden funkelnd hielt, dann aber wieder ungewiss wurde, weil die Erscheinung nur momentan Statt fand. Venus funkelte am gleichen Abend stark, und auch Mars sichtlich. Unter Umständen, welche den hier beim Cometen angegebenen sehr analog waren, habe ich seitdem Jupiter mehrmals sehr stark, Saturn einmal, ohne ganz volle Gewissheit zu erlangen, funkeln sehen, beide bei ziemlich hohem Stand.

"Zu den Acten über den Cometen möchte ich noch die Aufzeichnung mittheilen, welche mir mein College, Dr. *Butzl* (Professor der pathologischen Anatomie an der Universität, ein klarer Beobachter und physiologischen Sinnestäuschungen genau vertrauter Mann, zugleich ein fleissiger Betrachter des Himmels) über ein von ihm wahrgenommenes Phänomen mittheilt. Er schreibt darüber Folgendes:

"'Am 7 Octbr. Abends gegen 8 Uhr wurde ich bei Betrachtung des Cometen durch eine merkwürdige Erscheinung überrascht. Ich sah nämlich innerhalb des Schweifes, und zwar beiläufig von der Mitte seiner Länge beginnend, eine an Grösse und Leuchtkraft dem Kerne nahestehende Masse gegen den Kopf des Cometen hinzustürzen und in ihm stehen bleiben. Eine Verwechslung mit einer Sternschnuppe, welcher das Phänomen im Uebrigen ganz glich, scheint mir durchaus nicht wahrscheinlich, denn wenn man auch von dem Zufalle absehen wollte, dass die Richtung der Bewegung genau die Achse des Schweifes einhielt, sie nicht wirklich schnitt, so wäre es doch sonderbar, warum die Sternschnuppe nicht über den Kopf des Cometen hinaus sollte sichtbar gewesen sein, da sie unmittelbar vor dem Eintritte in den letzteren das schönste Licht entwickelte. — Schliesslich kann ich die Versicherung geben, dass ich mich an jenem Abende physisch vollkommen wohl und in der ruhigsten psychischen Verfassung befand, und mich unmöglich getäuscht haben kann.'

"Ich halte diese Wahrnehmung besonders deshalb für interessant, weil wir,

seitdem sie aufgezeichnet wurde, erfahren haben, dass an anderem Orte gleichzeitig dasselbe gesehen worden ist. Professor *Butzl* befand sich, als er die Erscheinung sah (nicht hier, sondern) in Straubing an der Donau; nun ist ganz dieselbe Erscheinung zu gleicher Zeit auf einem Spaziergange bei Augsburg (also etwa 18 geograph. Meilen von Straubing) vom Herrn Grafen v. *Hegnenberg-Dux* (dem Präsidenten unserer Abgeordneten-Kammer) gesehen worden.

"Derselbe erinnerte sich genau an Datum etc., und seine Beschreibung stimmt in jedem Stücke mit der von *Butzl* gegebenen überein, namentlich was die Bewegung des Phänomens längs der Schweif Achse und nicht über den Kopf hinaus angeht. Sollte man also dennoch genöthigt sein dasselbe für eine Sternschnuppe zu halten, so würde man wissen, dass sich dieselbe von den beiden Orten aus sehr nahe auf denselben Theil des Himmels projicirt hat."

VIENNA. STAMPFER. (*Astron. Nachrichten*, 1159, p. 103.)

"Befolgt diese Helligkeit wirklich das angenommene Gesetz, so wird der Komet die Lichtstärke eines Sternes 4 bis 3 Grösse erreichen und somit dem freien Auge sichtbar werden, da es um diese Jahreszeit $1\frac{1}{2}$ Stunde nach Sonnenuntergang schon nahehin ganz finster ist, und gleichzeitig der Komet in den ersten Tagen des October noch ziemlich hoch über dem Horizonte steht. Glücklicherweise ist auch der Mond abwesend."

(Ibid., 1163, p. 174.)

"Die Angabe in meinem Schreiben vom 14 August, dass der Komet die Helligkeit eines Sterns 3r Gr. erreichen werde, beruht auf der Voraussetzung, dass derselbe am 14 Juni mit einem Stern 10r Gr. gleich hell war, welche Annahme wohl bedeutend zu gering ist. Ich habe in den letzten Tagen den Kometen hinsichtlich der Helligkeit mit η Urs. Maj. verglichen und mit Rücksicht auf die Absorbtion der Atmosphäre gefunden

$$\text{Sept. } 25 \quad \frac{H\,☄}{H\,\ast} = 1.25$$
$$\text{Sept. } 30 \quad \text{"} \quad = 0.93$$

"Diese Messungen beziehen sich nur auf den Kern des Kometen und dessen hellste Umgebung und können nicht zur Beurtheilung des Gesetzes dienen, nach welchem die Helligkeit des Kometen sich ändert, da sein Kern trotz der Annäherung an die Erde sich rasch verkleinert und der leuchtende Stoff in den Schweif zerstreut wird."

MARSEILLES. VALZ. (*Bulletin Obs. Imp. de Paris.*) (For Oct. 15, 1858.)

"J'ai observé le passage de plusieurs étoiles à travers la queue de la comète, à 18′ seulement du noyau, sans pouvoir y reconnaître le moindre indice de ré-

fraction et cependant l'épaisseur en était au moins deux mille fois plus grande que celle de notre atmosphère, et les étoiles de 8ᵉ grandeur étaient entièrement absorbées par son intensité lumineuse à 8′ du noyau et même plus."

FRIGATE NOVARRA. WÜLLERSTORF. (*Astron. Nachrichten*, 1190, p. 217.)

"An Abenden, an welchen die Mondhelle nicht störend einwirkte, wurde die Lichtintensität, wie unten folgt, an dem von Professor *Stampfer* der Expedition mitgegebenen und in den von der kaiserlichen Academie der Wissenschaften in Wien redigirten 'Bemerkungen und Anweisungen' für die Naturforscher der Expedition beschriebenen Photometer beobachtet:

"Octbr. 9. Lichtintensität um 19^h 55^m m. Gr. Zt. gleich mit Vega: $11\frac{1}{2}$ Photometergrade. Um 20^h 21^m dasselbe Resultat; der Himmel stark bewölkt.

"Octbr. 12. Lichtintensität um 20^h 12^m m. Gr. Zt. wieder gleich mit Vega: 12 Photometergrade.

"Octbr. 14. Lichtintensität um 21^h 53^m m. Gr. Zt. bei $11\frac{1}{2}°$ Höhe des Cometen, dieselbe wie gleichzeitig von Vega: 11 Photometergrade. . . . . . Ziemlich reine Luft. . . . . .

"Octbr. 24. Um 20^h 24^m m. Gr. Zt. Lichtintensität des Cometen 8.5 und gleichzeitig die des 4° von ihm entfernten Sternes β Altaris 9.0 Photometergrade. . . . . .

"Octbr. 31. Um 20^h 48^m m. Gr. Zt. Lichtintensität des Cometen 7.5 (wie eines Sternes 3 Grösse) gleichzeitig die von β Altaris 8.5 Photometergrade. . . . . .

"Novbr. 8. Der Comet wurde zum letzten Male mit freiem Auge gesehen, konnte aber nicht mehr beobachtet werden.

"Novbr. 10. Bei völlig klarem Wetter mit freiem Auge keine Spur vom Cometen zu sehen."

Additional Observations relating to the Polarization of the Light of the Comet.

GREENWICH. AIRY. (*Monthly Notices Royal Astr. Soc.*, Vol. XIX. p. 12.)

"With a double refracting prism applied to the unarmed eye, one image of the tail nearly disappeared when the images were placed side by side, and the other when they were placed end to end. I found, upon comparing these effects with those produced on an image reflected from unsilvered glass, that the light is polarized in the plane of the comet's tail.

"On trying the light of the head in the same manner, as seen in the Sheepshanks telescope, there were feeble signs of polarization."

Berlin. Bruhns. (*Astron. Nachrichten*, 1205, pp. 71 – 73.)

"Schon früher habe ich einige Mal versucht, polarisirtes Licht in dem Cometenlicht zu erkennen, wegen der Schwäche der Cometen hatte ich aber bisher kein Resultat erhalten. Dieser Comet war der erste recht helle, und ich bereitete daher alles vor, um Resultate zu erhalten. Ausser einem *Nicolschen* Prisma, vor das sich ein senkrecht auf die Achse geschliffener Kalkspath schrauben liess, um darin im polarisirten Lichte Farbenringe zu sehen, hatte ich noch einen gewöhnlichen Kalkspath in Rhomboederform, und von Herrn Professor Dove einen Bergcristall, eine Gipsplatte, und einige grosse gekühlte Gläser erhalten.

"Am 21sten Sept., habe ich notirt, schien der Comet polarisirtes Licht zu haben, mit der Drehung des *Nicolschen* Prismas wurde sein Bild bald schwächer, bald heller, das Bild der Fixsterne blieb gleich hell; doch war Mondschein und das Resultat nicht zuverlässig.

"Ein sicheres Resultat erhielt ich Sept. 30, wo ich das *Nicolsche* Prisma am Cometensucher angebracht hatte, bei Drehung desselben, und zwar jedesmal wenn der stumpfe Winkel zur Sonne gekehrt war, wurde das Cometenlicht sowohl in der Umgebung des Kerns, als auch im Schweife bedeutend schwächer, bei 90° Drehung war es am hellsten.

"Oct. 6 zeigte sich mit dem *Nicolschen* Prisma sowohl mit blossem Auge, als am Cometensucher, als auch am Refractor dieselbe Erscheinung, wie Sept. 30, ich nahm am Refractor den Kalkspath und hielt zwischen ihm und dem Cometenbilde den Bergcristall und sah deutlich 2 gefärbte Bilder, ein rothes und ein grünes, die sich bei der Drehung des Kalkspathes mitdrehten. Durch die Gipsplatte und die gekühlten Gläser schienen die Bilder zu schwach zu sein, um Farben unterscheiden zu konnen.

"Um sicher zu sein, dass keine Täuschung stattfände, beobachtete ich mit denselben Apparaten Arctur, sah im Kalkspath 2 Bilder, aber weder durch den Bergcristall, noch durch die Gipsplatte und die gekühlten Gläser die geringste Spur vom Farbe.

"Oct. 7 sah ich ebenfalls mit dem Kalkspath und Bergcristall farbige Bilder, aber nicht so deutlich wie den Abend vorher.

"Von Oct. 7 – 15 war es trübe, an diesem letztern Abend war Mondschein, der Comet stand ausserdem so tief in der Dämmerung, dass die Untersuchung über das polarisirte Licht eine vergebliche gewesen wäre.

"Nur mit dem *Nicolschen* Prisma allein und mit dem Kalkspath und Bergcristall habe ich polarisirtes Licht erkannt, der senkrecht auf die Achse geschliffene Kalkspath absorbirte ebenso, wie die Gipsplatte (welche vielleicht dünner, Resultate

liefern wird; die meinige war etwa 3 Millimeter stark) und die gekühlten Gläser, (sie waren etwa 16 Millimeter dick,) zu viel Licht und bei ähnlichen Versuchen scheinen das *Nicolsche* Prisma und ein Polariscop aus Bergcristall und Kalkspath, wie es schon Arago hatte, diejenigen Mittel zu sein die das polarisirte Licht am leichtesten erkennen lassen.

"Der stumpfe Winkel des *Nicolschen* Prismas war immer zur Sonne gerichtet, d. h. in der Ebene Erde, Sonne, Comet, und darausfolgt, dass das Licht nicht durch Brechung, sondern durch Reflexion polarisirt war."

PARIS. CHACORNAC. (*Bulletin Obs. Imp. de Paris.*)

"Le 28 7bre en examinant l'astre à travers un prisme de Nicol, placé au foyer de la grande lunette, on voyait l'image de la comète varier notablement d'éclat à mesure qu'on imprimait à ce prisme un mouvement de rotation. Le minimum d'éclat avait lieu lorsque le petit diamètre du prisme était sensiblement parallèle à l'axe de la queue, et le maximum quand le plus grande diamètre se trouvait parallèle à ce même axe.

"La différence d'intensité des deux images de la comète vue à travers le prisme de Nicol placé dans l'une et l'autre position, a été mesurée en comparant photométriquement la comète à une étoile voisine."

(Ibid. *Comptes Rendus*, Vol. XLVIII. p. 236.)

"J'ai l'honneur de faire connaître à l'Académie que les observations sur la polarisation de la lumière de la comète de Donati faites par moi à l'Observatoire impérial de Paris sont à l'abri des objections de M. d'Abbadie.

"Toutes les fois que j'ai constaté de la lumière polarisée dans l'éclat de la tête de la comète, les lueurs du crépuscule étaient entièrement éteintes; mais outre cette précaution indispensable, voici celles que j'ai prises encore dans les observations que j'ai faites sur cette comète.

"Chaque jour, mon appareil, appliqué à la grande lunette de 32 centimètres d'ouverture, a été préalablement essayé sur la lumière polarisée de l'atmosphère, et j'ai toujours vu que la polarisation de la lumière du crépuscule était encore sensible à l'œil nu avec l'appareil, alors qu'elle ne l'était plus dans la lunette, quoique celle-ci fût armée d'un faible grossissement.

"La lumière polarisée de la comète était extrêmement apparente dans la lunette, au contraire elle était à peine perceptible à l'œil nu dans l'appareil.

"Du 10 septembre au 8 octobre je n'ai constaté, soit pendant la nuit, soit au moment du plus faible crépuscule, aucune coloration pour les étoiles ν Grande Ourse, 12 α Chiens de Chasse et Arcturus, en me servant de l'appareil appliqué à la grande lunette de l'Observatoire.

"La lumière de ces étoiles, perçue à travers un prisme de Nicol, placé au foyer

de l'objectif de la lunette, ne variait pas d'intensité, lorsqu'on imprimait un mouvement de rotation au prisme."

Rio de Janeiro. Liais. (*Comptes Rendus*, Vol. XLVIII. p. 626.)

"La comète a été trouvée polarisée tant dans le noyau que dans la queue. Le plan de cette polarisation passait par le soleil. La polarisation a été mesurée par un polarimètre composé d'un prisme biréfringent, à l'aide duquel on cherchait les situations donnant la plus grande différence d'intensité des deux images. On choisissait parmi les deux positions correspondantes celle pour laquelle les deux images ne se projétaient pas l'une sur l'autre, et qui avait lieu quand la section principale était perpendiculaire à l'axe de la queue. À l'aide d'une tourmaline on ramenait les deux images à l'égalité. L'angle de cette tourmaline et de la section principale faisait connaître le rapport de la quantité de lumière polarisée à la lumière totale. Ce rapport a été croissant du 24 octobre au 6 décembre. Il était le 24 octobre, 0.086; le 31, 0.082; le 3 décembre, 0.092; et le 6, 0.108."

(Ibid., p. 627.)

"La seconde partie de mon Mémoire est employée à la discussion des observations de polarisation et d'intensité. Leur comparaison avec les distances au soleil et les angles entre le soleil et la terre vus de la comète tend à démontrer:

"1°. Que la comète ne possède pas de lumière propre sensible.

"2°. Que sa lumière se composait de deux parties; l'une réfléchie régulièrement et donnant de la polarisation, l'autre réfléchie irrégulièrement et non polarisée comme celle des nuages.

"3°. La deuxième espèce de lumière décroissait dans un rapport beaucoup plus grand que la première, ce qui indique que la matière nébuleuse contenue dans le milieu transparent allait en se dissolvant ou se déposant à mesure que l'astre s'écartait du soleil.

"4°. L'intensité de la comète ne dependait pas seulement de la distance au soleil, mais aussi de l'angle formé par les rayons incidents et réfléchis comme dans l'atmosphère terrestre, qui est plus lumineuse dans la région du soleil qu'à une certaine distance angulaire de cet astre.

"Enfin j'ai calculé les volumes de la comète d'après les observations et à l'aide de ces distances à la terre, et de l'angle sous lequel était vu l'axe de la queue, et j'ai trouvé que ce volume n'a pas sensiblement décru par la disparition de la queue du 3 au 6 décembre, et qu'il aurait plutôt augmenté.

"D'une manière générale, le volume aurait plutôt diminué qu'augmenté du 21 octobre au 6 décembre, et la comparaison des variations observées avec les observations photométriques indique que la disparition de la comète a eu lieu progressivement de la circonférence au centre."

(Ibid., p. 951.)

"Avant de connaître la note de M. d'Abbadie, j'ai adressé à l'Académie mes observations, non pas au polariscope mais au polarimètre, sur la comète de Donati; et je crois qu'elles sont à l'abri des objections relativement à la polarisation atmosphérique. Dans tous les cas où j'ai observé, je me suis toujours assuré de l'absence de polarisation auprès de la comète, surtout à cause de la remarque que j'ai faite plusieurs fois en mer, à savoir: que l'atmosphère est sensiblement polarisée à 90 degrés des planètes Jupiter et Venus, remarque qui concorde avec les observations de M. d'Abbadie.

"Dans un numéro plus récent du *Compte rendu* (séance du 21 février) je vois que M. Brewster élève de nouveaux doutes au sujet de la polarisation de la lumière des comètes. Mes observations au sujet de la polarisation de la comète Donati sont à l'abri de ses objections, puisque j'ai déterminé le plan de polarisation, lequel passe par le soleil. Non-seulement j'ai fait tourner la lunette sur elle-même, mais j'ai changé l'oculaire pour faire varier l'intensité par le grossissement. Les résultats ont été les mêmes. De plus, dans ma note *sur la hauteur de l'atmosphère*, communiquée à l'Académie dans la séance du 10 janvier, j'ai déjà dit que j'ai appliqué à la comète de Donati la méthode dont je m'étais servi pour la lumière zodiacale, à savoir: la différence d'intensité des petites étoiles vues à travers, et cela dans deux positions rectangulaires d'une tourmaline ou d'un prisme de Nicol, et que ce procédé, qui m'avait donné un résultat négatif pour la lumière zodiacale, m'a, au contraire, donné un résultat positif pour la comète de Donati. L'expérience considérée par M. Brewster dans sa note comme la plus caractéristique de la lumière polarisée a donc été faite. J'ajouterai encore que mes observations au polarimètre ont eu lieu en faisant varier l'intensité tantôt par un changement d'oculaire, tantôt par addition d'un second prisme biréfringent dont la section principale faisait un angle d'environ 45 degrés avec celle du premier et créait deux nouvelles images qui toutefois ne recouvraient pas les premières. J'ai même tiré parti de ce second prisme biréfringent à l'aide d'une disposition convenable prise dans la construction de l'appareil pour doubler et rendre par là plus sensible l'excès sur 45 degrés de l'angle de la tourmaline, c'est-à-dire la lecture du polarimètre. Mais dans le calcul des proportions de lumière polarisée, que j'ai donné dans mon mémoire sur la comète, j'ai tenu compte de cet accroissement d'angle."

OBSERVATORY OF HARVARD COLLEGE. LOVERING. (*Proceedings Am. Academy*, Vol. IV. p. 102.)

"I have twice visited the Observatory of Harvard College, and examined the light of this brilliant Comet, when condensed in the focus of the great equatorial refractor. On the first of these occasions a Nicol's prism was used, and the changes in the brightness of the image corresponding to the rotation of the analyzer were

very decided; and the positions of maxima and minima were indicated with complete unanimity in many independent experiments by Mr. Bond and myself.

"These experiments were made in such a way as to guard against self-delusion, — the experimenter not being able to see the position of his analyzer while he was judging of its positions of maximum and minimum transmission of the light. On the second occasion, Savart's polariscope was used, in which plates of quartz and tourmaline are so combined as, with polarized light, to give colored fringes. The first glance through the polariscope at the light of the comet, condensed in the focus of the telescope, showed the field of view traversed by colored fringes, and betrayed strong traces of polarization."

Havana. Poey. (*Comptes Rendus*, Vol. XLVIII. p. 728.)

"Sept. 26. En faisant usage soit de la lunette polariscope et chromatique d'Arago, soit de son simple polariscope ou de celui de Savart également chromatiques, les deux premiers jours de l'apparition de la comète Donati, je n'ai pu découvrir aucune trace de polarisation. Mais j'ai attribué ce fait aux vapeurs d'eau qui diminuaient considérablement la transparence de l'air et rendaient la perception du phénomène difficile à saisir, attendu que dans les soirées suivantes pures et sereines, j'ai toujours obtenu des traces de lumière réfléchie dont le plan de polarisation m'a semblé correspondre à la ligne médiane qui unissait le centre du soleil au centre de la queue, quelle que fût du reste la position angulaire de la queue de la comète. Mais à mesure que la comète s'approchait de l'horizon ou lorsque les rayons lunaires diminuaient considérablement l'intensité de sa lumière, les effets de polarisation devenaient de plus en plus difficiles à saisir."

The following observations were accidentally omitted in their proper place: —

September 29. Observatory of Harvard College. G. P. Bond.

The following measurements were taken: —

Nucleus to vertex c' of inner envelope C,	17″.8
Nucleus to inner edge of the bright arch of B in the direction of vertex,	25.1
Nucleus to vertex b' of envelope B (outer edge of bright arch),	31.3

October 9. Ann Arbor. Brünnow. (*Mss.*)

"On the next clear evening, Oct. 9th, this condensation [the secondary nucleus] had disappeared; but in the same direction there was a jet of light from the nucleus, and above it a comparatively dark spot. The rings were not symmetrical to the nucleus, but were farthest from it, and also brightest, where the jet of light was. The intervals between the rings were filled again with some light matter."

IX. ON THE OUTLINE OF THE HEAD OF THE COMET.

The outlines of the head of the comet upon Plates XLVII. and XLVIII. have been constructed by the following process.

The outlines and the position of the nucleus have first been traced from the original figures upon thin plates of mica. These represent, as nearly as practicable, a curve of equal brightness near the outer margin of decided nebulosity, and usually a little within its extreme limits. The very faint external envelope, or veil, called by German astronomers the "Umhüllung," has not been regarded in making the tracings. The curves were divided into fifteen groups, arranged according to their dates, so that figures of neighboring dates only were included in the same group. The originals, having been drawn on different scales, and the value of the scale having been seldom stated, the following method was used for combining all the members of a group into a single normal, and finally for reducing this normal to a common scale adopted for all the groups.

A point, k, situated in the axis, was determined for each tracing, by the condition that its distance from the curve on either side, in the direction perpendicular to the axis, should be, as nearly as possible, equal to its distance from the vertex, while it was, at the same time, symmetrically placed with reference to the two branches of the outline above the parallel of k.* This point will be symmetrically situated in all the curves, if errors in the drawing of the original are left out of account. The tracings were then imposed one on the other, adjusting them so as to bring their axes and the points k into coincidence. Straight lines were next drawn in different directions from k, intersecting all the curves. The points of intersection with the outlines by each line were then combined into a single point, p_0, giving to each a weight proportional to the assumed value of the original figure. A curve drawn through all the points, p_0, was adopted as the mean of all the curves combined. The corresponding place of the nucleus was the mean of its separate positions, having regard to the same system of weights used in combining the tracings. As the original figures are of different

* This was effected by drawing upon mica two lines at right angles to each other, and placing the sheet upon the figures, with the angle at the vertex; the lines were adjusted so as to cut off equal, and, as nearly as possible, similar segments of the outline. The points where they crossed the outline were connected by a straight line, the intersection of which with the axis was taken for the position of k.

lengths, the lower lines drawn from k would occasionally fail of intersecting one or more of the curves, in which cases a proper correction has been applied for the change of scale in the resulting curve, which would be occasioned by the absence of any members of the original system.

After combining the individual outlines as here described, they were finally brought to a common scale, by making the distances of the symmetrical point k from the vertex the same in all. The fifteen normals derived as here described are represented on Plate XLVII.; the places of the nucleus are indicated by a cross. The last figure is that which results from the combination of the whole series into a single one. It is given on an enlarged scale on Plate XLVIII.

The following is a list of the dates of the original drawings or sketches, and of the places at which they were made. The weights used for their combination are also given.

Copenhagen,	wt. = 3.	Aug. 24, 31; Sept. 3, 23, 26, 28, 29, 30; Oct. 1, 5, 6.
Munich,	wt. = 2.	Oct. 3, 4, 7, 10, 14, 16, 18.
Markree,	wt. = 3.	Sept. 20, 28; Oct. 4, 5, 7, 8, 11, 16.
Altona,	wt. = 2.	Sept. 22, 28; Oct. 1, 4, 6, 9, 12.
Dessau,	wt. = 1.	Oct. 4, 10.
Rome, Collegio Romano,	wt. = 1.	Sept. 4, 11, 16, 22, 29; Oct. 2, 4, 8, 9, 11, 13, 15, 17, 18, 19, 22.
Melbourne, Australia,	wt. = 2.	Oct. 12, 13, 14, 24; Nov. 7, 12.
Poulkova,	wt. = 3.	Sept. 12, 16, 18, 22, 24, 25, 30; Oct. 5, 7, 8, 9, 13.
Cambridge, Eng.,	wt. = 2.	Sept. 27, 30; Oct. 2, 5, 6, 8, 9, 11, 15, 16.
Haddenham, Eng.,	wt. = 3.	Sept. 24; Oct. 5, 8, 11, 17.
Greenwich, Eng.,	wt. = 3.	Oct. 2, 3, 4, 5, 9, 11, 15.
Hamilton College, N. Y.,	wt. = 3.	Oct. 7, 10, 15, 17.
Bradstones, Liverpool, Eng.,	wt. = 3.	Sept. 12; Oct. 3, 4, 5, 8.
Observatory of Harv. Coll.,	wt. = 3.	Sept. 8, 20, 24, 25, 28; Oct. 2, 6, 8, 9, 10, 11, 15, 18, 19.
Geneva,	wt. = 2.	Sept. 26; Oct. 3, 5, 6, 7, 9, 13, 14, 15.

It is evident from the large discrepancies which are found among these figures, that but little stress should be laid upon the comparatively small variations which will be noticed in the outlines upon Plate XLVII.

Beyond a slight approximation of the nucleus towards the vertex in some of the earlier figures, as may be seen by comparing the normals for Sept. 17th with those on Sept. 30th, Oct. 7th, and Oct. 14th, Plate XLVIII., it is remarkable that they present scarcely any obvious systematic differences, such as might have been anticipated as an effect of the perspective foreshortening of the true outline, or that which the Comet would have presented if the line of vision had been directed at right angles to the axis of the tail.

lengths the lower lines drawn from k would occasionally fail of intersecting one or more of the curves, in which case a proper correction has been applied for the change of scale in the resulting curve, which would be occasioned by the absence of any member of the [illegible] system.

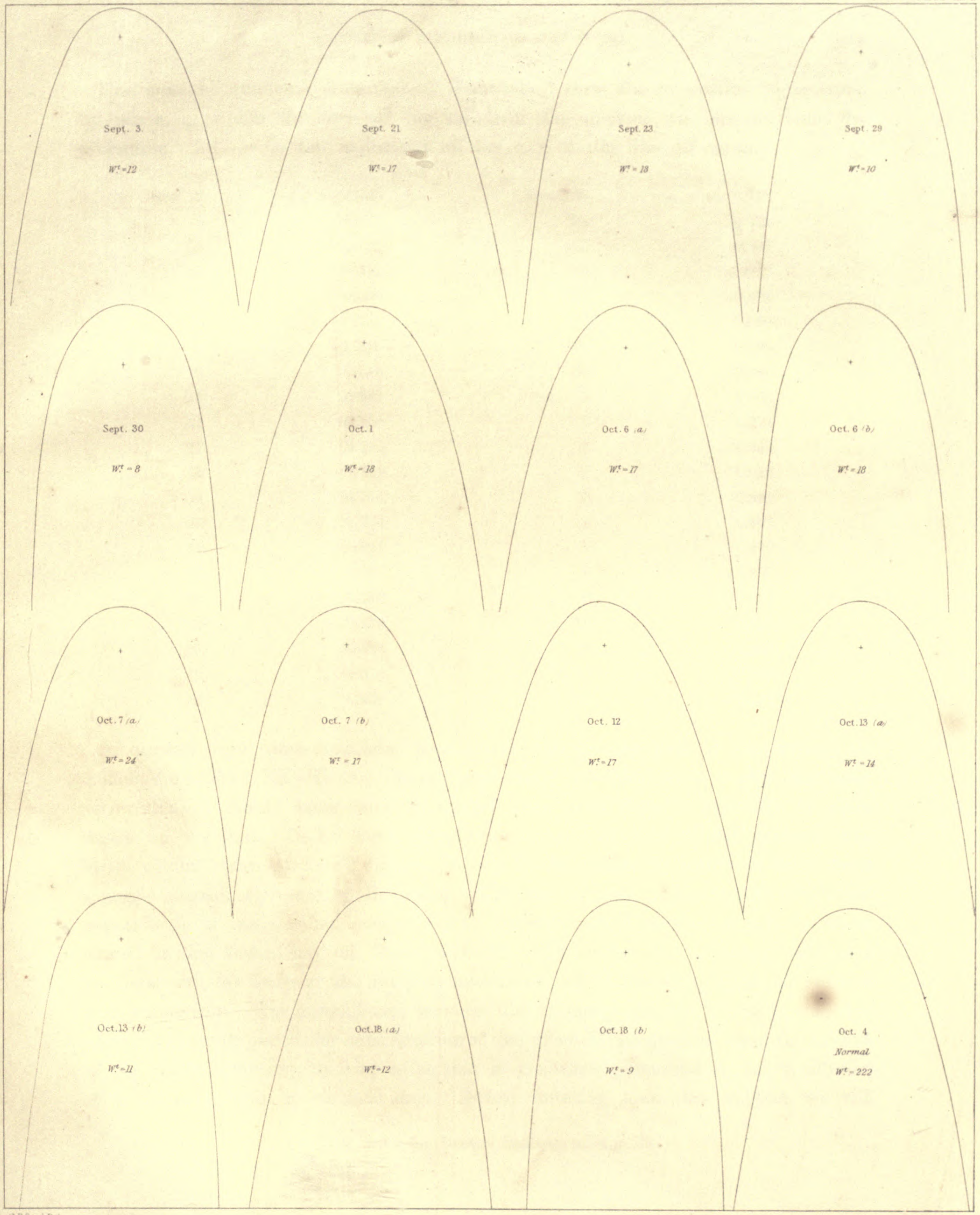
After combining the [illegible] as here described, they were finally brought to a common scale by making the distances of the symmetrical point k from the [illegible] the same in all. The fifteen normals derived as here described are represented on Plate XLVII.; the places of the nucleus are indicated by a [illegible] The last figure is that which results from the combination of the whole series into a single one. It is given on an enlarged scale on Plate XLVIII.

The following is a list of the dates of the original drawings or sketches, and of the places at which they were made. The [illegible] combination are also given.

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Cape College [illegible]	[illegible]	[illegible]	[illegible] 17, 18, 19, 22.
Melbourne, Australia	[illegible]	[illegible]	[illegible]
Pulkova,	[illegible]	Sept. [illegible]	[illegible]
Cambridge, Eng.,	[illegible]	Sept. [illegible]	[illegible]
Haddenham, Eng.,	[illegible]	Sept. 21 [illegible]	[illegible]
Greenwich, Eng.,	[illegible]	Oct. [illegible]	[illegible]
Hamilton College, N. Y.	[illegible]	[illegible]	[illegible]
[illegible], Liverpool, Eng.	[illegible]	[illegible]	[illegible]
Observatory of Harv. Coll.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

It is evident from the [illegible] figures, that but little stress [illegible] which only be [illegible]

Second it might [illegible] some of the earlier [illegible] Sept. 17th with those [illegible] Plate XLVIII. It is remarkable that [illegible] might have been [illegible] true outline, or that [illegible] had been directed at right angles [illegible]



G. P. Bond Del.

J. W. Watts Sc.

COMET OF DONATI 1858.

NORMAL OUTLINES OF HEAD

Printed by Chas. D. Andrews

The annexed numbers, computed by Winnecke,* show the proportion represented by cos. ν, in which the axis of the tail near the nucleus was foreshortened by projection. $90° - \nu$ is the inclination of the axis to the line of vision.

Sept. 2 . . .	cos. ν = 0.453	Sept. 23 . . .	cos. ν = 0.957
3	0.471	24	0.972
4	0.492	25	0.984
5	0.515	26	0.993
6	0.539	27	0.998
7	0.564	28	1.000
8	0.590	29	0.998
9	0.616	30	0.993
10	0.642	Oct. 1	0.984
11	0.668	2	0.971
12	0.694	3	0.956
13	0.721	4	0.940
14	0.748	5	0.922
15	0.775	6	0.907
16	0.801	7	0.895
17	0.827	8	0.887
18	0.852	9	0.885
19	0.876	10	0.887
20	0.898	11	0.895
21	0.919	12	0.908
22	0.939	13	0.925

It appears from these numbers, that during the greater part of the interval included upon Plate XLVII. the Comet must have presented very nearly the same aspect that it would have done if it had been seen from a direction at right angles to the axis. Under these circumstances, and in view of the general similarity of the entire series of figures, it will be admissible to construct from them a single normal representing the mean of all the outlines. This normal, which corresponds to a mean value, cos. $\nu = 0.91$, having regard to the weights, is represented in the lower half of Plate XLVIII. The curve of a catenary, and of a parabola with its focus at the nucleus, have been added for the purpose of convenient comparison. The resemblance between the catenary and the Comet outline has suggested a more particular consideration of the effect of perspective upon the outline of the head, supposing its form to be that of a surface generated by the revolution of a catenary upon its vertical axis. Before entering upon this subject, we will

* Pulk. Beob. des Grossen Cometen, 1858, p. 52.

collect the observed dimensions of the head of the Comet, which will be used in the discussion.

To reduce the outlines to angular measurement, a scale has been supplied to the figures, by ascertaining from the observed breadths the distance from the nucleus of a symmetrical point in the axis; that is, where $a = b$ in the notation already adopted. This point, it will be noticed, is not the same as k, but the change of origin to the nucleus will be more convenient since most of the original measurements have been referred to it.

The following are the observed dimensions of the head of the Comet, and of the tail near the nucleus. The numbers, in a few instances, (such, for example, as the results from the transit of the tail over Arcturus, Oct. 5,) have been derived from projections or from figures drawn to a scale. Those measurements which belong to the outer faint veil, "Umhüllung," have not been included. For the notation, a has been used to denote the distance from the nucleus, the sign being positive when on the same side with the tail; b is the corresponding breadth.

Dimensions of the Head, and of the Tail near the Nucleus.

1858.			
Aug. 30.	Vienna	$a =$ 0′.0	$b =$ 5′.0
30.	Vienna	$a = +60.0$	$b = 10.0$
Sept. 2.	Poulkova	$a = -1.5$	$b = 0.0$
2.	Poulkova	$a = 0.0$	$b = 3.5$
4.	Poulkova	$a = -1.3$	$b = 0.0$
8.	Obs. Harv. Coll.	$a = -1.0$	$b = 0.0$
8.	Obs. Harv. Coll.	$a = +3.0$	$b = 2.5$
10.	Vienna	$a = 0.0$	$b = 5.0$
10.	Vienna	$a = +30.0$	$b = 15.0$
10.	Vienna	$a = +60.0$	$b = 15.0$
12.	Bradstones	$a = +20.0$	$b = 12.0$
12.	Poulkova	$a = -1.7$	$b = 0.0$
12.	Poulkova	$a = 0.0$	$b = 4.0$
12.	Poulkova	$a = +10.0$	$b = 6.5$
14.	Poulkova	$a = -0.7$	$b = 0.0$
14.	Poulkova	$a = 0.0$	$b = 1.5$
		to	4.0
16.	Poulkova	$a = +5.0$	$b = 7.0$
16.	Poulkova	$a = +13.0$	$b = 9.5$
16.	Poulkova	$a = +26.0$	$b = 14.0$

1858.			
Sept. 18.	Poulkova	$a = -$ 0′.4	$b =$ 0′.0
18.	Poulkova	$a = 0.0$	$b = 1.5$
18.	Poulkova	$a = +4.0$	$b = 3.0$
24.	Obs. Harv. Coll.*	$a = +5.0$	$b = 4.0$
24.	Poulkova	$a = +2.0$	$b = 2.5$
24.	Poulkova	$a = +6.0$	$b = 5.0$
25.	Obs. Harv. Coll.*	$a = -1.5$	$b = 0.0$
25.	Obs. Harv. Coll.*	$a = 0.0$	$b = 3.3$
25.	Obs. Harv. Coll.	$a = -12.0$	$b = 5.5$
25.	Poulkova	$a = +5.0$	$b = 6.3$
25.	Poulkova	$a = +10.0$	$b = 9.0$
25.	Poulkova	$a = +26.0$	$b = 11.7$
26.	Poulkova	$a = +10.0$	$b = 10.0$
26.	Poulkova	$a = +30.0$	$b = 13.0$
26.	Poulkova	$a = +60.0$	$b = 17.0$
27.	Poulkova	$a = +5.0$	$b = 6.0$
27.	Poulkova	$a = +10.0$	$b = 8.5$
27.	Poulkova	$a = +26.0$	$b = 11.0$
27.	Poulkova	$a = +53.0$	$b = 13.5$
29.	Collegio Romano	$a = 0.0$	$b = 4.6$

* From sketch.

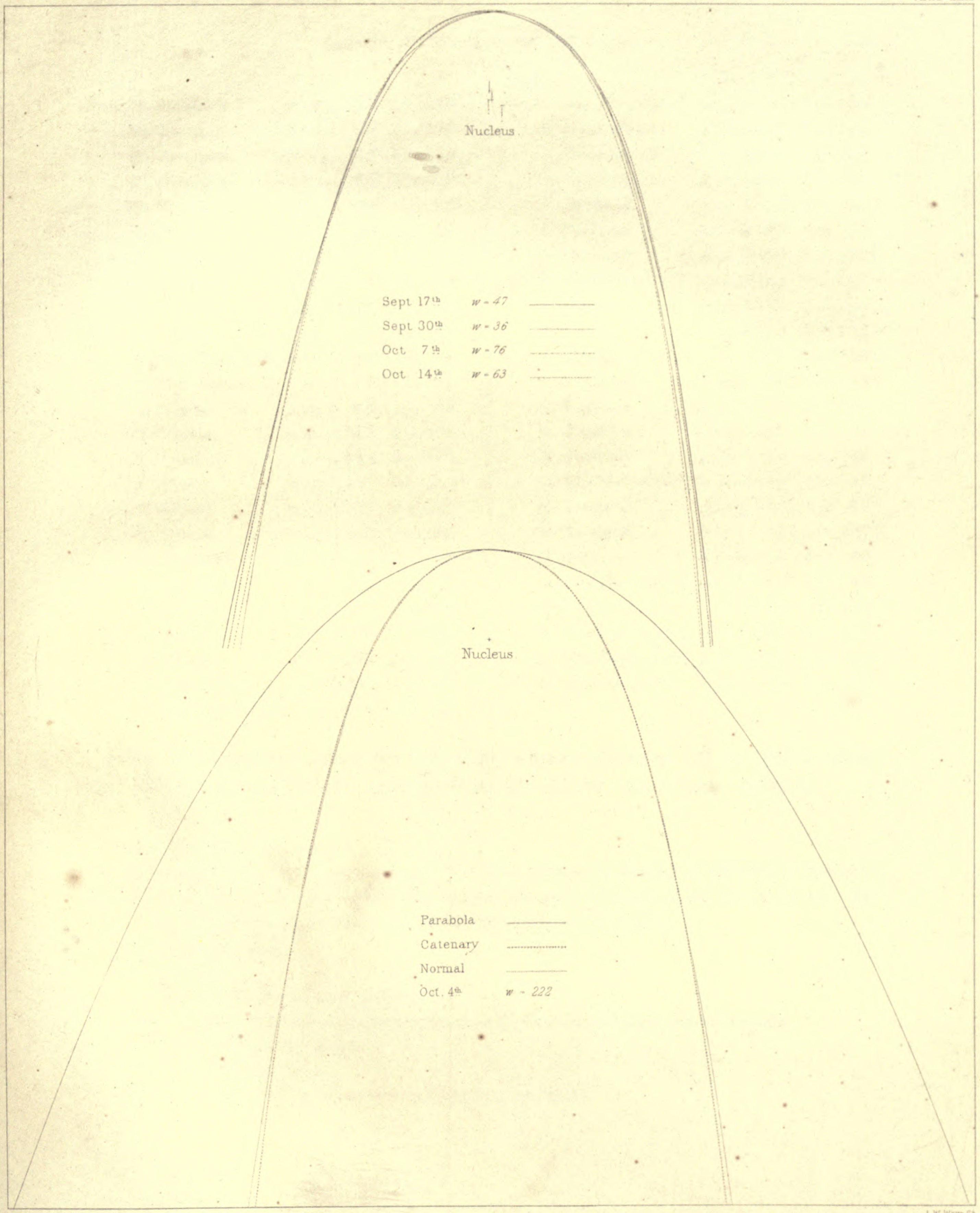
collect the observed dimensions of the head of the Comet, which will be used in the discussion.

To reduce the breadths to angular measurement, a scale has been [illegible] to the figures, by [illegible] from the observed breadths the distance from the nucleus [illegible] the axis; that is, where $a = b$ in the nota[illegible] already adopted. This [illegible], it will be noticed, is not the same as [illegible], but the [illegible] nucleus will be more convenient since most of the [illegible] have been referred to it.

The following are the observed dimensions of the head of the Comet, and of the tail near the nucleus. The numbers in a few instances (such, for example, as the results from the [illegible] of the tail [illegible]) have been derived [illegible] or from figures [illegible] which belong [illegible] have not been [illegible]. For the [illegible] have been used to denote the distance from the nucleus, the sign being [illegible] with the tail [illegible].

Dimensions of the Head, and of the Tail near the Nucleus.

1858.			1858.		
Aug. 29. Vienna	[illegible]	Sept.	16. Poulkova	$a =$ [illegible]	$b =$ 0.0
30. Vienna	[illegible]		16. Poulkova	[illegible]	$b =$ 1.5
Sept. 2. Poulkova	[illegible]		16. Poulkova	[illegible]	$b =$ 3.0
2. Poulkova	[illegible]		16. Obs. Harv. Coll.	[illegible]	$b =$ 4.0
4. Poulkova	[illegible]		[illegible]	[illegible]	$b =$ 2.5
8. Obs. Harv. Coll.	[illegible]		[illegible]	[illegible]	$b =$ 5.0
8. Obs. Harv. Coll.	[illegible]		[illegible]	1.5	$b =$ 0.0
10. Vienna	[illegible]		[illegible]	0.0	$b =$ 3.3
10. Vienna	[illegible]		[illegible]	[illegible]	$b =$ 5.5
10. Vienna	[illegible]		[illegible]	[illegible]	$b =$ 6.3
12. [illegible]	[illegible]		[illegible]	[illegible]	$b =$ 9.0
12. Poulkova	[illegible]		[illegible]	[illegible]	$b =$ 11.7
12. Poulkova	[illegible]		[illegible]	[illegible]	$b =$ 10.0
12. Poulkova	[illegible]		[illegible]	[illegible]	$b =$ 13.0
14. Poulkova	[illegible]		[illegible]	[illegible]	$b =$ 17.0
14. Poulkova	[illegible]		[illegible]	0.0	$b =$ 6.0
				$a = +10.0$	$b =$ 8.5
16. Poulkova	[illegible]			$a = +26.0$	$b =$ 11.0
16. Poulkova	[illegible]			$a = +53.0$	$b =$ 13.5
16. Poulkova	[illegible]		[illegible]	$a =$ 0.0	$b =$ [illegible]



G. P. Bond Del.

J. W. Watts Sc.

COMET OF DONATI 1858.

NORMAL OUTLINES PARABOLA AND CATENARY

1858.			
Sept. 29.	Poulkova	$a = +60'.0$	$b = 23'.0$
30.	Liverpool	$a = -\ 1.4$	$b = \ 0.0$
30.	Liverpool	$a = [\ \ 0.0]$	$b = [5.8]$
30.	Poulkova	$a = -\ 0.8$	$b = \ 0.0$
30.	Poulkova	$a = \ \ 0.0$	$b = \ 2.3$
30.	Poulkova *	$a = +\ 4.2$	$b = \ 5.2$
30.	Poulkova	$a = +\ 5.0$	$b = \ 5.0$
30.	Poulkova	$a = +10.0$	$b = \ 7.0$
30.	Poulkova	$a = +26.0$	$b = 14.5$
Oct. 1.	Oxford	$a = \ \ 0.0$	$b = \ 4.1$
2.	Obs. Harv. Coll.	$a = +\ 8.0$	$b = \ 5.0$
2.	Obs. Harv. Coll.	$a = +\ 1.7$	$b = \ 0.0$
2.	Vienna	$a = +\ 6.5$	$b = \ 6.6$
2.	Vienna	$a = +34.7$	$b = 15.9$
2.	Vienna †	$a = +62.8$	$b = 17.9$
3.	Vienna	$a = +15.7$	$b = 10.8$
3.	Vienna	$a = +35.9$	$b = 15.2$
3.	Vienna	$a = +58.3$	$b = 19.0$
4.	Liverpool	$a = -\ 1.5$	$b = \ 0.0$
4.	Liverpool	$a = \ \ 0.0$	$b = \ 4.5$
4.	Vienna	$a = +\ 7.1$	$b = \ 8.2$
4.	Vienna	$a = +25.9$	$b = 14.0$
4.	Vienna	$a = +43.4$	$b = 18.4$
5.	Copenhagen ‡	$a = +20.7$	$b = 15.0$
5.	Obs. Harv. Coll. §	$a = \ \ 0.0$	$b = \ 3.0$

1858.			
Oct. 5.	Obs. Harv. Coll. §	$a = -\ 1'.0$	$b = \ 0'.0$
5.	Haddenham ‖	$a = +20.7$	$b = 14.0$
5.	Haddenham ¶	$a = +60.0$	$b = 17.7$
5.	Greenwich	$a = +10.3$	$b = 10.3$
5.	Poulkova	$a = +\ 5.0$	$b = \ 6.0$
5.	Poulkova	$a = +\ 5.0$	$b = \ 5.5$
5.	Poulkova	$a = +13.0$	$b = \ 8.0$
5.	Poulkova	$a = +26.0$	$b = 14.0$
7.	Vienna	$a = +16.7$	$b = 12.0$
7.	Vienna	$a = +39.3$	$b = 15.2$
8.	Liverpool	$a = [-3.6]$	$b = [0.0]$
8.	Liverpool	$a = [\ \ 0.0]$	$b = [8.8]$
8.	Poulkova	$a = +13.0$	$b = 13.0$
8.	Poulkova	$a = +26.0$	$b = 15.0$
9.	Poulkova	$a = +\ 5.0$	$b = \ 6.0$
10.	Obs. Harv. Coll. **	$a = +\ 5.0$	$b = \ 5.0$
10.	Liverpool	$a = [-4.3]$	$b = \ 0.0$
10.	Liverpool	$a = [\ \ 0.0]$	$b = [10.7]$
13.	Poulkova	$a = +\ 3.0$	$b = \ 6.5$
15.	Obs. Harv. Coll. **	$a = +\ 5.0$	$b = \ 4.3$
17.	Clinton ††	$a = +15.0$	$b = 10.0$
19.	Obs. Harv. Coll. ‡‡	$a = +12.0$	$b = \ 5.0$
19.	Obs. Harv. Coll. ‡‡	$a = +50.0$	$b = \ 6.0$
30.	Cape of G. H.	$a = \ \ 0.0$	$b = \ 4.7$

From these measurements the following angular distances of the point where the breadth is equal to the distance from the nucleus have been obtained.

* From transit of comparison star.

† The values of a for the Vienna observations have been obtained by dividing the difference of declination from the nucleus to the observed point, by the cosine of the angle of position of the axis of the tail. The value of b for $a = 62'.8$ has been corrected from $19'.8$, as printed in the original.

‡ From D'Arrest's figure.

§ From sketch.

‖ From the transit of the tail over Arcturus.

¶ From the angles of position of tangents combined with observed breadths at greater distances.

** Brighter part of tail. From sketch.

†† Outside limit of bright light.

‡‡ See remarks on p. 70, from which these numbers have been taken.

Normal Breadths of Tail near the Nucleus.

1858.		1858.		1858.	
Sept. 8	$a = b = 6'.2$	Sept. 21	$a = b = 5'.3$	Oct. 4	$a = b = 8'.4$
9	5.9	22	5.5	5	8.5
10	5.7	23	5.6	6	8.6
11	5.5	24	5.9	7	8.6
12	5.4	25	6.2	8	8.7
13	5.3	26	6.6	9	8.7
14	5.2	27	6.9	10	8.7
15	5.1	28	7.2	11	8.6
16	5.1	29	7.5	12	8.5
17	5.1	30	7.7	13	8.3
18	5.1	Oct. 1	7.9	14	8.0
19	5.2	2	8.1	15	7.5
20	5.2	3	8.3		

If we reduce these, by means of the outlines, to a distance of 10′ from the nucleus, and compare the results with the breadths of the tail at the same point read off from the charts constructed from observations made with the naked eye, or with telescopes of low power, as given on pp. 115–117, we shall find that the latter have sensibly larger values; a circumstance readily explained by the greater diffusion of the margin in the telescope, and the consequent difficulty of recognizing the nebulosity until it had attained a certain degree of density somewhat within its full limits.

To proceed with the investigation of the effect of perspective upon the outline, we will designate the enveloping surface of the head of the Comet, as above defined, by C, and represent by M and N the vertical and horizontal co-ordinates of a point P, upon the generating curve, taking the lowest point of the catenary for the origin; by τ, the angle which the tangent at P makes with the axis of M; and by ν, the inclination of the axis of M to the plane upon which the outline is supposed to be projected. The circle described by the revolution of the point P about the axis, will be projected as an ellipse having for its semi-axes

$$\alpha = N,$$
$$\beta = N \sin. \nu.$$

The similar ellipses corresponding to all positions of P represent the projection of the surface C, and a curve drawn tangent to them so as to include them all without intersection will be the required outline. Hence, if we denote by ξ and η the co-ordinates of a point p on one of these ellipses, its centre being the origin,

and p the point where it touches the outline, we shall have the following equations for determining the co-ordinates x and y of the required outline:

$$x = \xi, \qquad\qquad y = M\cos.\nu + \eta,$$

$$\alpha^2\eta^2 + \beta^2\xi^2 = \alpha^2\beta^2,$$

$$\frac{dy}{dx} = \frac{d\eta}{d\xi};$$

the last equation being the condition for the coincidence of the tangents of the two curves at p. We have then from the above,

$$(y - M\cos.\nu)^2 = (N^2 - x^2)\sin.^2\nu;$$

$$\frac{dy}{dx} = \frac{dM}{dx}\cos.\nu + \left(N\frac{dN}{dx} - x\right)\frac{\sin.^2\nu}{\eta}.$$

And at the point p,

$$\frac{dy}{dx} = \frac{d\eta}{d\xi} = -\sin.^2\nu\,\frac{\xi}{\eta}.$$

Combining the last two equations, and making $\xi = x$, they give

$$0 = \frac{dM}{dx}\cos.\nu + \frac{dN}{dx}N\frac{\sin.^2\nu}{\eta}.$$

Hence,

$$\eta = -N\frac{dN}{dM}\frac{\sin.^2\nu}{\cos.\nu}, \qquad\qquad \xi = N\sqrt{1 - \left(\frac{dN}{dM}\right)^2\tan.^2\nu}.$$

In which, if we make $\tan.\tau = \frac{dN}{dM}$,

τ being the angle which the tangent to the catenary at P makes with the vertical axis, and

$$\cos.\gamma = -\tan.\nu\tan.\tau,$$

we have, finally,

$$\xi = N\sqrt{1 - \tan.^2\nu\tan.^2\tau},$$

$$\eta = -N\sin.\nu\tan.\nu\tan.\tau;$$

or,

$$\xi = \alpha\sin.\gamma, \qquad\qquad \eta = \beta\cos.\gamma.$$

For those points where ν is greater than $90° - \tau$, the surface is not seen in profile, and γ becomes imaginary.

To obtain from these equations the position of a point in the curve of the projected outline of the head of the Comet at a given inclination of the axis to the line of sight, supposing its figure to be that of the surface C, we must substitute the co-ordinates M and N of the point P in the generating curve and the angle of the tangent τ. We shall then have for the axes of the ellipse,

$$\alpha = N, \qquad\qquad \beta = N\sin.\nu,$$

and, as above,

$$\cos.\,\gamma = -\tan.\,\nu\,\tan.\,\tau,$$

$$\xi = \alpha \sin.\,\gamma, \qquad \eta = \beta \cos.\,\gamma;$$

and for the point p in the projected outline,

$$x = \xi, \qquad y = M \cos.\,\nu + \eta.$$

The numbers subjoined are the horizontal distances, designated by δx, between points in the generating curve, and in the projected outline of C for different values of ν. For convenience in description, the catenary is supposed to be inverted, in order to present it under the same aspect with the outlines on the Plates; in this position, the origin is at the vertex. The points of intersection of the curves with their vertical axes, as well as the axes themselves, are supposed to coincide; their relative position being similar to that of the parabola and catenary in the lower group on Plate XLVIII. The unit for δx is the breadth of the catenary at the point where the breadth is equal to the distance from the origin, that is, the value of $2N$ when $2N = M$. At this point the inclination of the tangent to the vertical in the catenary is $\tau = 9° 44'.0$.

Corrections of the apparent Outline of C for the effect of Perspective.

Distance from the Vertex.	$\nu = 0° 0'$ cos. $\nu = 1.000$.	$\nu = 25° 51'$ cos. $\nu = 0.900$.	$\nu = 36° 52'$ cos. $\nu = 0.800$.	$\nu = 60° 0'$ cos. $\nu = 0.500$.
0.0	$\delta x = 0.00$	$\delta x = -0.00$	$\delta x = -0.00$	$\delta x = -0.00$
0.1	.00	.01	.01	.05
0.2	.00	.01	.02	.06
0.3	.00	.01	.02	.07
0.4	.00	.01	.02	.08
0.5	.00	.01	.03	.09
0.6	.00	.01	.03	.09
0.7	.00	.01	.03	.10
0.8	.00	.01	.03	.10
0.9	.00	.01	.03	.10
1.0	.00	.02	.03	.10
1.1	.00	.02	.03	.11
1.2	.00	.02	.04	.11
1.3	.00	.02	.04	.11
1.4	0.00	-0.02	-0.04	-0.11

These differences will be considerably diminished if the projected outline be compared, not with the catenary in its original proportions, but with the same

curve slightly enlarged *in scale;* or otherwise, if we make the comparisons after first reducing the outline in such a proportion as to bring it nearly into coincidence with the catenary. The latter process being somewhat more convenient, we will compare the catenary with the projected outlines reduced in the proportions,

For $\nu = 0^\circ\ 0'$	$\cos.\ \nu = 1.000$	1 : 1.000
$= 25\ 51$	$= 0.900$	1 : 1.051
$= 36\ 52$	$= 0.800$	1 : 1.105
$= 60\ \ 0$	$= 0.500$	1 : 1.338

The following are then the least distances, denoted by δp, of the two curves apart, after they have been adjusted to the best coincidence. The positive sign indicates that the outline is within the catenary. The unit for δp is the same as for δx.

Projected Outline, reduced in Scale, compared with Catenary.

Distance from the Vertex.	$\nu = 0^\circ\ 0'$ $\cos.\ \nu = 1.000$.	$\nu = 25^\circ\ 51'$ $\cos.\ \nu = 0.900$.	$\nu = 36^\circ\ 52'$ $\cos.\ \nu = 0.800$.	$\nu = 60^\circ\ 0'$ $\cos.\ \nu = 0.500$.
0.0	$\delta p = 0.000$	$\delta p = +0.001$	$\delta p = +0.003$	$\delta p = +0.005$
0.1	.000	—0.001	0.000	—0.002
0.2	.000	0.002	—0.002	0.008
0.3	.000	0.001	0.004	0.007
0.4	.000	0.001	0.005	0.006
0.5	.000	0.001	0.004	0.004
0.6	.000	0.001	0.003	—0.002
0.7	.000	—0.001	—0.001	0.000
0.8	.000	0.000	0.000	+0.002
0.9	.000	0.000	+0.001	0.005
1.0	.000	0.000	0.002	0.008
1.1	.000	+0.001	0.003	+0.012
1.2	.000	0.001	0.005	. . . .
1.3	.000	0.001	+0.006	. . . .
1.4	0.000	+0.002	. . . .	. . . .

If we put M_0, N_0, and y_0 for the values of M, N, and y corresponding to the apparent vertex, we shall have for this point

$$\nu = 90^\circ - \tau, \qquad \cos.\ \gamma_0 = 1, \qquad y_0 = M_0 \cos.\ \nu - N_0 \sin.\ \nu.$$

If n is the distance of the nucleus from the vertex, $n \cos.\ \nu$ will be its distance from the origin projected. Hence its distance from the apparent vertex will be

$$N_0 \sin.\ \nu + (n - M_0) \cos.\ \nu\ ;$$

and the correction to be applied to its distance from the apparent vertex to reduce it to the distance for $\nu = 0$ will be

$$\delta n = n - N_0 \sin. \nu - (n - M_0) \cos. \nu.$$

The following values of δn depend on the position of the nucleus $n = 0.242$, which is the mean result from the observed figures reduced for the effect of projection to $\nu = 0$. The same unit has been used as for δx and δp, viz. the value of $2N$ when $2N = M$. A positive sign indicates that the effect of perspective is to bring the nucleus nearer to the apparent vertex than it is to the true vertex corresponding to $\nu = 0$.

$\nu = 0° \; 0'$	$\cos. \nu = 1.000$	$\delta n = 0.000$
$= 25 \; 51$	$= 0.900$	$= +0.005$
$= 36 \; 52$	$= 0.800$	$= +0.006$
$= 60 \; 0$	$= 0.500$	$= -0.007$
$= 63 \; 0$	$= 0.454$	$= -0.013$

Substituting, in place of the unit which has been adopted for δp and δn, its value in angular measurement, derived from the dimensions already given of the head of the Comet, we find that within a distance of 6′.7 from the nucleus the maximum value of δp is less than 0′.08, during the interval for which outlines are given on Plate XLVII., viz. Sept. 3d to Oct. 18th. As this limit is too small to be recognized in the observations, it follows that one of the principal phenomena exhibited in the observed figures, namely, the permanent character of the outline while the angle between the axis and the line of sight was changing through an arc of nearly 90°, has been satisfactorily accounted for.

With regard to the position of the nucleus, it is to be noticed that, while diminishing the scale of the projected outline, to bring it into accordance with the catenary, we must at the same time diminish in an equal proportion the distance of the nucleus from the apparent vertex in order to retain it in its proper position relatively to the outline. Hence the distances (n) of the nucleus from the apparent vertex corresponding to the values of δp will be, using the same unit as above,

$\nu = 0° \; 0'$	$\cos. \nu = 1.000$	$(n) = 0.242$
$= 25 \; 51$	$= 0.900$	$= 0.226$
$= 36 \; 52$	$= 0.800$	$= 0.214$
$= 60 \; 0$	$= 0.500$	$= 0.186$

If now we ascertain the observed value of (n) from the normal outlines for

Sept. 17, Sept. 30, Oct. 7, and Oct. 14, Plate XLVIII., obtaining the unit $M = 2N$ for each curve separately, and applying the corrections δx, we have the following numbers: —

Comparison of Computed and Observed Distances of the Nucleus from the Vertex of the Outline.

	(n) Computed.	(n) Observed.	c — o. $M = 2N = 1$.	c — o. In arc.
Sept. 17	0.217	0.214	+ 0.003	+ 0.01
30	.241	.226	+ 0.015	+ 0.10
Oct. 7	.225	.247	— 0.022	— 0.16
14	.233	.237	— 0.004	— 0.03

Here also the agreement with observation is not unfavorable, and is an additional confirmation of the hypothesis which has been made respecting the actual form of the head of the Comet.

It will be interesting to examine further, whether the breadths of the tail, corrected for perspective and reduced to the unit of distance from the earth, agree with the assumed figure, in which the sections by planes perpendicular to the axis are circles.

After correcting the apparent figures for the effect of perspective by means of the values of δx and reducing to the unit of distance of the Comet from the Earth, $\Delta = 1$, we obtain the following results, in which b' is the breadth corresponding to the distance a' from the nucleus when the Comet is viewed from a direction at right angles to the axis and at the unit of distance.

Breadths of the Tail.

Sept. 10	$a' = 6'.0$	$b' = 6'.3$	$a' = 10'.0$	$b' = 7'.2$
15	6.0	5.7	10.0	6.6
20	6.0	5.3	10.0	6.0
25	6.0	5.5	10.0	6.3
30	6.0	5.6	10.0	6.3
Oct. 5	6.0	5.1	10.0	5.8
10	6.0	4.8	10.0	5.4
15	6.0	4.8	10.0	5.4

The apparent diminution of breadth would seem to indicate that the diameter of the head of the Comet was smaller in the direction of the plane of the orbit, than at right angles to it; since, owing to the change of position of the Earth and Comet, the direction of the line of vision had altered in the interval between Sept. 10th and Oct. 15th, from being nearly in the plane of the orbit to a position almost at right angles to it. The breadths deduced from the charts

indicate, however, just the opposite, b' increasing instead of diminishing with the later dates. This fact, together with the uncertainty of the data, especially near the beginning and end of the series, leave it questionable whether any variation took place in the value of b'. There seems then at least no decisive evidence from observation opposed to the hypothesis that the sections are circles. This is also the conclusion reached by Winnecke, by employing his own observations between Sept. 12th and Oct. 8th.*

It will be noticed that the preceding discussion necessarily depends on the assumed constancy of the form of the head throughout the entire apparition of the Comet.

X. ON THE BRANCHES AND CENTRAL DARKNESS OF THE TAIL.

In Section I., under the dates Aug. 23, 24, 31, and Sept. 2 and 12, will be found particular mention of the separation of the tail into two branches, enclosing between them a comparatively dark interval. This feature was preserved with more or less decision throughout the entire apparition in the northern hemisphere, and we find it expressed in figures of the Comet made in the southern hemisphere as late as November. On the 24th of August, the right-hand branch, as seen in the telescope, — that following in the order of right ascension, — already surpassed the other in density and distinctness of outline; for several weeks there seems to have been no marked alteration beyond a gradual strengthening of the contrast, as the Comet increased in brightness. From the middle to the 20th of September the difference in the aspect of the two branches became more decided, so as to attract general attention; it reached a maximum about the time of the perihelion passage, Sept. 30th, or perhaps a day or two later. A change now took place rapidly. According to Pape, the left branch had become brightest on the 4th of October, but others defer this to a few days later. On the 8th, the envelopes were most distinct on the left side, and on the 9th, and subsequently, the left branch was brightest, or at least was not inferior to the other near the nucleus. It would seem from some accounts that in more distant parts of the tail the convex side still maintained its superiority. In the earliest and latest figures of the Comet, the branching seems to have been little more than a

* Pulk. Beob. des Grossen Cometen 1858, p. 54.

brightening up of the light near the margin. For about two weeks, beginning with the 20th of September, the branches were defined on the inner side by a very conspicuous dark region, at first narrow and strongly outlined, and subsequently becoming broader and less distinct. The following is a summary of the principal notices of the branches and of the central darkness.

Sept. 8th to 20th. Right-hand branch as seen in telescope bright and well defined. The left-hand comparatively faint, with hazy and uncertain limits.

Sept. 20th to 24th. Very strong contrast in the brightness of the two branches. Central darkness becomes conspicuous, and has a definite parabolic outline, touching the nucleus at its vertex. Its breadth at 5′ from the nucleus is about one eighth of the whole breadth of the tail. Its central line is not in the middle of the tail, but inclines towards the faint left-hand branch.

Sept. 24th to 30th. The contrast of the branches continues. The central darkness very conspicuous. Its outline, with the vertex precisely at the nucleus, forms the lower limit of the inner envelopes. On Sept. 25th, its breadth at 6′ from the nucleus was about one eighth of the whole breadth of the tail. From the 28th to the 30th, this proportion was variously estimated at from one fourth to one twelfth, different gradations being probably taken for its limit. Struve and Webb describe it as occupying one eighth of the breadth.

After the 1st of October, the dark zone widened, and became less distinct; its increased breadth, and the approach of the Comet to the Earth caused the branches to appear to diverge at a larger angle on Oct. 9th, and subsequently for at least one or two weeks the left branch in the telescopic view was usually brighter than the right.

The following numbers are estimates of the relative space occupied by the branches and the dark zone.

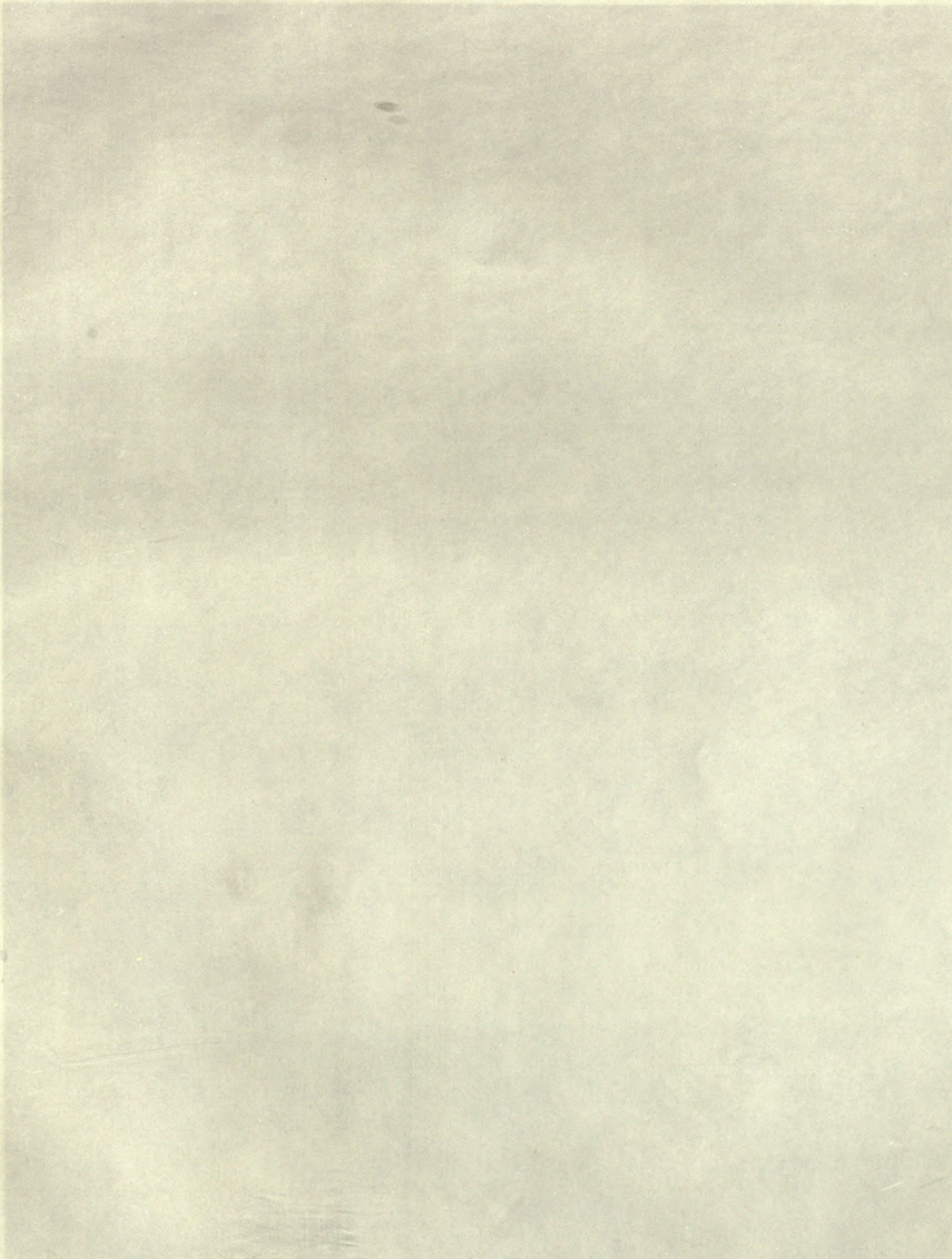
1858.	Sept. 28	Markree	Right branch :	Zone :	Left branch	=	2 :	1 :	1
	" 30	Struve	"	"	"	=	11 :	3 :	10
	" 30	Webb	"	"	"	=	4 :	1 :	3
	Oct. 3	Galle	"	"	"	=	3 :	1 :	2
	" 3	Vienna	"	"	"	=	3 :	1 :	2
	" 4	Webb	"	"	"	=	3 :	. . . :	2
	Oct. 4	Galle	"	"	"	=	3 :	2 :	2
	" 4	Vienna	"	"	"	=	21 :	8 :	13
	" 7	Vienna	"	"	"	=	47 :	11 :	20
	Oct. 9	Struve	"	"	"	=	5 :	4 :	3
	" 11	Webb	"	"	"	=	1 :	6 :	1
	" 13	Struve	"	"	"	=	5 :	2 :	1

The last numbers of the series are inconsistent, but the limit of the zone had become altogether indistinct.

In addition to the dark zone above described, there was a narrow, dark canal, with straight outlines carried quite up to the nucleus, which escaped general observation, and has only in a comparatively few instances been clearly distinguished from the broad zone. Close in the rear of the nucleus the canal was singularly dark, quite as much so to appearance as the background of the sky; its outlines were there sharply defined, and perfectly straight, and separated at their origin by a space precisely equal to the diameter of the nucleus. At a little distance they were lost in the dark zone, the side next to the bright branch of the tail being the most easily traced and continued farthest into the tail. The appearance was commonly described as the shadow of the nucleus, or as a shadow-like appendage to it. If a shadow was actually visible, it most probably could not have been distinguished, as to its aspect, from the similar effect which would have been produced by the streaming off of luminous matter from the surface of the nucleus in a sensibly straight line, having an unoccupied space directly in its rear, and of even breadth with it. The only exact measurements of the direction of the canal which I have found expressly designating it as a feature distinct from the dark zone, are those made at the Observatory of Harvard College. The following are the differences between the angles of position of the canal and of the radius vector from the Sun prolonged; p denotes the angle of position of the canal, and p_0 that of the prolongation of the radius vector.

1858.	Sept. 29	$p_0 - p = -3^\circ\ 4'$		
	Oct. 2	$= +2\ 45$	Following edge of canal.
	" 4	$= 2\ 32$	"
	" 5	$= 4\ 54$	"
	" 8	$= 2\ 50$	
	" 9	$= 4\ 49$	
	" 15	$= +2\ 32$	

These numbers indicate a deviation from the direction of the radius vector of the same sign with the deviation of the axis of the tail as investigated by Pape and Winnecke, but somewhat less in amount. They do not necessarily exclude the idea of the superposition of an actual shadow near the nucleus, since the measurements represent the direction of a point in the canal at too large a distance from the nucleus to exhibit any sensible influence from a shadow, if such existed. Dr. Peters at Hamilton College has discriminated carefully between the zone and the canal, and has in several instances remarked the inclination of the



The last numbers of the series are inconsistent, but the limit of the zone had become altogether indistinct.

In addition to the dark zone above described, there was a narrow, dark canal, with straight outlines carried quite up to the nucleus, which escaped general observation, and has only in a comparatively few instances been clearly distinguished from the broad zone. Close in the rear of the nucleus the canal was singularly dark, quite as much so to appearance as the background of the sky; its outlines were there sharply defined, and perfectly straight, and separated at their origin by a space precisely equal to the diameter of the nucleus. At a little distance they were lost in the dark zone, the side next to the bright branch of the tail being the most easily traced and continued farthest into the tail. The appearance was commonly described as the shadow of the nucleus, or as a shadow-like appendage to it. If a shadow was actually visible, it most probably could not have been distinguished, so far as [illegible], from the effect which would have been produced by the streaming off of nebulous matter from the surface of the nucleus in a steadily [illegible] direction, leaving the space directly in its rear [illegible]. [illegible] the direction of the canal which I have found [illegible] distinct from the dark zone, [illegible] at the Observatory of Harvard College. The following are the differences between the angles of position of the canal and of the radius vector from the Sun prolonged; p denotes the angle of position of the canal, and p_0 that of the prolongation of the radius vector.

[illegible] following edge of canal.

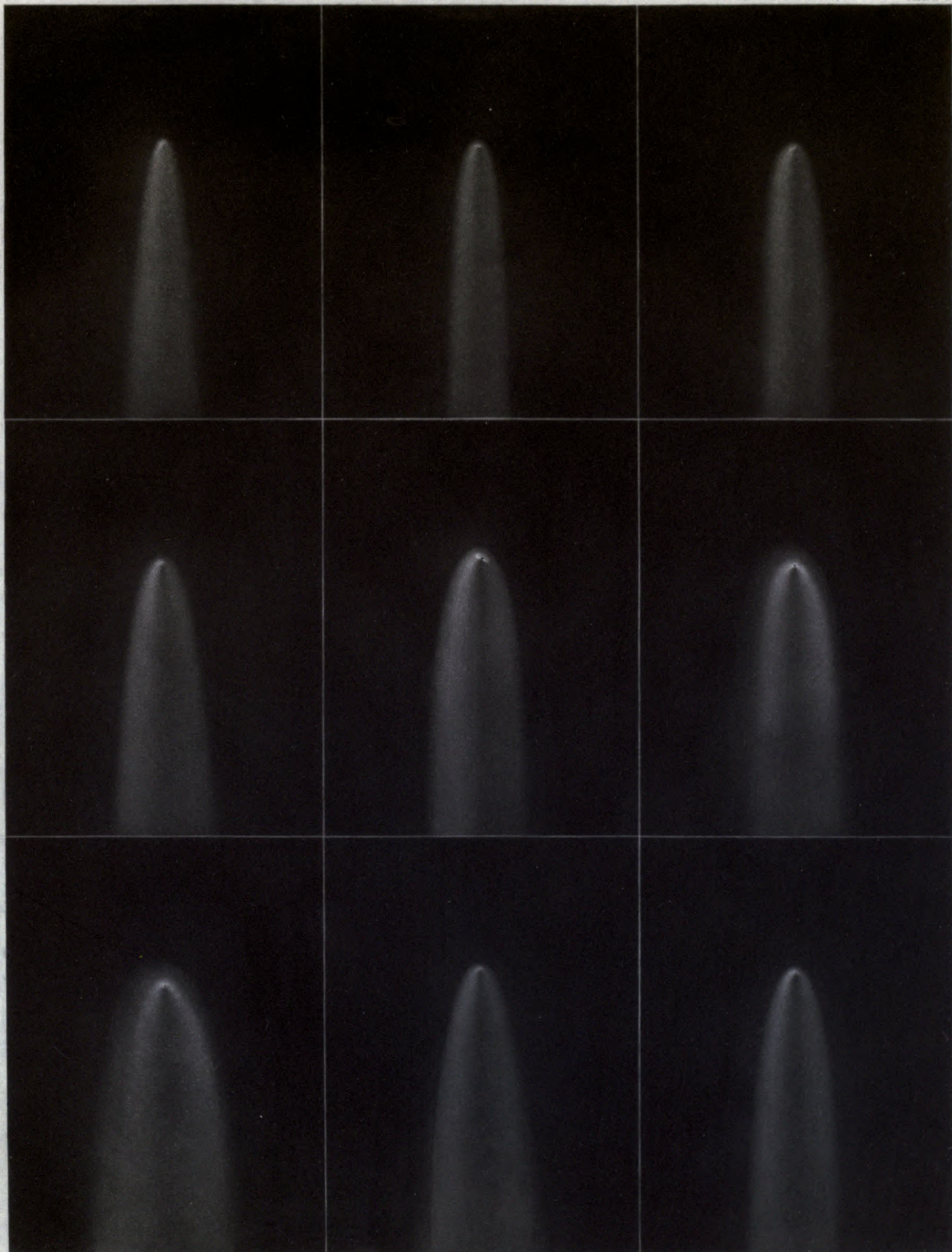
[illegible]

These numbers indicate a deviation from the direction of the radius vector of the same sign with the deviation of the [illegible] as investigated by Pape and Winnecke, but somewhat less in amount. They do not necessarily exclude the idea of the superposition of an actual shadow near the nucleus, since the measurements represent the direction of a point in the canal at too large a distance from the nucleus to exhibit any sensible influence from a shadow, if such existed. Dr. Peters at Hamilton College has discriminated carefully between the zone and the canal, and has in several instances remarked the inclination of the

COMET III 1860.

OBSERVATORY OF HARVARD COLLEGE

PLATE I.



G. P. Bond Del.

J. W. Watts Sc.

SCALE 8' TO AN INCH.

1860 JUNE 21ST	1860 JUNE 22ND	1860 JUNE 24TH
" " " " 25TH	" " " " 26TH	" " " " 27TH
" " " " 28TH	" " " " 30TH	" " JULY 1ST

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latter towards the (apparent) right-hand branch of the tail, which would tend to diminish the value of $p_0 - p$. The blackness of the region just in the rear of the nucleus, and its sharply defined edges, were frequently mentioned as noticeable peculiarities. It is interesting to trace in the observations a very evident connection between the changes in the aspect of the envelopes and corresponding changes in the branches. The most obvious instance of this was the alteration in the relative brightness of the two branches which followed a decided change in the disposition of the envelopes. The connection is readily explained, if we suppose the branches to be simply the effect of the aggregation of the paths of particles dispersed from the envelopes, and becoming more or less dense on either side according to the disposition of the latter. The Comet of June, 1860 (1860, III.), furnished a good illustration of the changes to which the phenomenon of the branching of the tail may be subjected in the course of a few days, and of their connection with the envelope formation. On Plate L. are represented nine telescopic views of this Comet, taken at the Observatory of Harvard College, at the dates June 21, 22, 24, 25, 26, 27, 28, 30, and July 1, 1860. The appearance in the telescope and comet-seeker was as follows.

On the 21st of June, no dark streak or hollow was seen, but the (apparent) left-hand side was much brighter than the other, — by the best estimate that could be made, it was twice as bright as the opposite half. By the 25th, the branches and central dark zone were well developed, the left side remaining much the brighter. On the 26th, the left-hand branch comprised three fourths of the whole light. The nucleus had thrown off a new emission of an irregular figure, the dispersion of which into the tail was distinctly visible on the following evening, the 27th, as far as a distance of 7′ from the nucleus, up to which point it had restored the two branches to a perfect equality in brightness. On the 28th, both branches were symmetrical and equally bright, excepting near the parallel of the nucleus, where there was a considerable effusion of nebulosity on the left side. The equalization of the two branches reached as far as 30′ from the nucleus. It is probable that the matter thrown off from it on the 26th had now reached to that distance. On June 30th and July 1st, the branches were once more decidedly unequal, the left-hand being much the brighter, as it had been previously to the 27th. Within a few days later, the branches and the inequality of brightness had disappeared.

Additional remarks on the connection of the envelopes with the branching of the tail will be found in Section XII.

XI. THE NUCLEUS.

The term nucleus, as it has been applied in the original observations, has no precise significance. Sometimes it has been used to designate almost the whole head of the Comet as it appeared to the naked eye, sometimes in a sense including one or more of the brighter envelopes, and again it has been confined to the brilliant star-like point, as distinguished by its brightness and appearance of solidity from the nebulosity about it. Whether a true nucleus was at any time seen, disengaged from the surrounding nebulosity, is of course open to question. We have sufficient evidence, from observations made at about the times of nearest approach to the Earth and Sun, when the opportunities were most suitable for determining its true diameter, that the solid centre, if there were any, could not have been so much as five hundred English miles in diameter; whereas the great mass of measurements indicate a size many times greater, especially at the time when the Comet was most distant from the Earth. In July and August, for instance, the measurements made with the great refractor of the Observatory of Harvard College give a diameter greater by nearly ten times than was indicated by observations with the same instrument made in the first week of October.

This apparent increase in dimensions when the Comet was most distant from the Earth is good evidence that the true nucleus was not generally seen, and that, if it really existed, it was concealed from view by a surrounding nebulous atmosphere sufficiently dense to present a nuclear aspect. This may readily be supposed to be subject to considerable changes, even before the appearance of the regularly formed envelopes, and to have ill-defined outlines, which would be differently estimated according to the distance of the Comet from the Earth; the limits assigned to it would also vary with the optical power under which they were viewed, the larger telescopes penetrating nearer to the centre. This explains the apparent diminution in size and brightness which took place immediately upon the disengagement of a new envelope; the latter in its earliest stage being quite undistinguishable from the nucleus itself, and, when separated, leaving it evidently smaller and less brilliant than before. These variations, however, owing to the small angle subtended by the nucleus, were more sensible in their effect upon the eye, than in the measured diameters. The following is a collection of the measured diameters of the so-called nucleus, as it appeared in the telescopic view, reduced to the unit of distance from the Earth.

Where measurements in two directions have been given in the observations, the smaller axis only has been retained. Where the measurement has evidently included a large area of mere nebulosity generally distinguishable from the bright centre, the corresponding diameter has been enclosed in brackets. The distance of the Comet from the Earth at the date of every *tenth* observation is also added. It may be remarked here, that with the more powerful telescopes, and at about the time of the perihelion, the side of the nucleus opposite to the sun was always the best defined, and frequently presented a perfectly sharp outline, while the other was hazy and without precise limit.

Diameters of the Nucleus, reduced to the Distance $\Delta = 1$.

1858.			
July 19.	Obs. Harv. Coll.	12″.0	$\Delta = 2.39$
Aug. 30.	Obs. Harv. Coll.	10.1	
Sept. 2.	Copenhagen	16.0	
2.	Copenhagen	2.4	
2.	Poulkova, Struve	4.0	
4.	Poulkova, Winnecke	10.1	
7.	Berlin, Förster	8.9	
8.	Obs. Harv. Coll.	4.2	
11.	Poulkova, Winnecke	10.0	
12.	Poulkova, Struve	4.5	
12.	Poulkova, Winnecke	9.5	$\Delta = 1.30$
12.	Bradstones	(13.0)	
13.	Berlin, Förster	7.7	
13.	Poulkova, Struve	5.7	
13.	Poulkova, Winnecke	5.1	
15.	Berlin, Förster	9.1	
16.	Dorpat	5.8	
16.	Poulkova, Winnecke	4.0	
17.	Dorpat	4.0	
17.	Poulkova, Struve	4.0	
18.	Poulkova, Struve	2.2	$\Delta = 1.10$
18.	Poulkova, Winnecke	1.8	
19.	Dorpat	3.7	
19.	Poulkova, Winnecke	2.8	
20.	Collegio Romano	6.1	
21.	Berlin, Förster	(9.5)	
21.	Dorpat	3.5	
22.	Poulkova, Winnecke	2.2	
23.	Obs. Harv. Coll.	2.8	

1858.			
Sept. 24.	Obs. Harv. Coll.	2″.2	
24.	Poulkova, Struve	1.8	$\Delta = 0.89$
24.	Poulkova, Winnecke	1.8	
25.	Berlin, Förster	3.4	
25.	Dorpat	2.5	
28.	Altona	1.9	
29.	Kremsmünster	(11.0)	
29.	Collegio Romano	(6.2)	
29.	Poulkova, Winnecke	2.0	
30.	Poulkova, Winnecke	1.4	
30.	Florence	2.1	
30.	Liverpool	(11.9)	$\Delta = 0.70$
30.	Dorpat	1.2	
30.	Collegio Romano	(6.1)	
Oct. 1.	Oxford, Slatter	(6.1)	
2.	Obs. Harv. Coll.	3.4	
2.	Clinton	2.3	
3.	Florence	1.8	
3.	Bradstones	4.2	
4.	Berlin, Bruhns	2.9	
4.	Liverpool	(12.1)	
4.	Bradstones	4.0	$\Delta = 0.60$
5.	Obs. Harv. Coll.	0.9	
5.	Oxford, Slatter	2.8	
5.	Poulkova, Struve	2.9	
6.	Göttingen, Auwers	1.6	
6.	Obs. Harv. Coll.	1.7	
6.	Berlin, Bruhns	2.6	
7.	Berlin, Bruhns	3.1	

Oct. 7.	Florence	1″.8		Oct. 11.	Obs. Harv. Coll.	1″.1	
7.	Dorpat	1.2		11.	Liverpool	(12.4)	
7.	Kremsmünster	(6.1)	$\Delta = 0.55$	11.	Oxford, Slatter	4.3	$\Delta = 0.54$
7.	Poulkova, Struve	1.7		13.	Florence	2.8	
7.	Poulkova, Winnecke	1.5		13.	Geneva	(6.6)	
8.	Florence	2.0		13.	Poulkova, Struve	1.7	
8.	Göttingen	1.5		13.	Poulkova, Winnecke	1.8	
8.	Poulkova, Winnecke	1.9		13.	Florence	2.8	
8.	Obs. Harv. Coll.	2.4		14.	Geneva	(6.5)	
8.	Liverpool	(12.0)		14.	Collegio Romano	3.6	
8.	Dorpat	0.9		15.	Florence	2.8	
8.	Oxford, Slatter	1.1		15.	Geneva	(5.8)	
9.	Christiania	1.0	$\Delta = 0.54$	16.	Collegio Romano	3.3	$\Delta = 0.60$
9.	Dorpat	0.8		17.	Collegio Romano	3.6	
9.	Florence	2.5		18.	Obs. Harv. Coll.	1.9	
9.	Oxford, Slatter	4.9		19.	Obs. Harv. Coll.	2.0	
9.	Poulkova, Struve	1.5		20.	Obs. Harv. Coll.	1.4	
9.	Poulkova, Winnecke	1.6		23.	Cape of Good Hope	3.1	
10.	Obs. Harv. Coll.	1.4		25.	Cape of Good Hope	3.7	
10.	Göttingen	1.2		30.	Cape of Good Hope	4.3	
10.	Kremsmünster	4.8		31.	Cape of Good Hope	3.9	$\Delta = 1.00$

The increase in the diameter at the larger distances from the Earth is well exhibited in the above numbers, but in any attempt to explain the phenomenon it would be necessary to take into account several conditions which may be supposed to affect its aspect. Amongst these may be specified, the intensity of illumination received from the Sun, and the changes in the Comet's atmosphere produced by the Sun's influence; the effect of projection in causing the nucleus to be seen in the same direction with a varying thickness of the nebulosity of the head; the rate of increase of density in the nebulosity in approaching the nucleus, and the manner in which the apparent diameter would be affected by it; and, lastly, the more or less favorable position of the Comet which would, in the present instance, have manifested itself by a tendency to exaggerate the diameter on account of the indistinctness of outline at the earlier dates, when the Comet was generally near the horizon at the times of observation, and more exposed to atmospheric disturbances.

One inference, however, may be drawn from the results with tolerable certainty, which is, that the solid part of the nucleus subtended, at the distance $\Delta = 1$, an angle of less than 1″, and consequently that its diameter was less than 500 English miles.

The disposition of the nebulosity in the head of the Comet, particularly as exhibited in the succession of envelopes, each with its centre of brightness, lying between the nucleus and the Sun, must have had a perceptible influence upon the point observed as the centre of the nucleus. For instance, at about the time of the perihelion passage, an observer using only the unassisted eye, or a very low magnifying power, would not have been able to distinguish between the nucleus and the bright masses within a distance of 30″ or more on its sunward side. The assumed centre of brightness would evidently be taken at a point too near the Sun, on account of central darkness or general deficiency of light in the rear of the nucleus. There would be a similar tendency even with large telescopes; for it is quite certain that, so long as the envelopes continue from their density and proximity to be undistinguishable from the nucleus, the observed place of the latter will incline towards the centre of brightness of the envelope. The generally imperfect recognition of the envelopes, and the large discrepancies in the diameter of the nucleus, which are plainly occasioned by confounding the latter with the former, are sufficient evidence that errors from this source may reach an appreciable value. If phenomena of a similar nature take place with all comets, as is not improbable, it may be deserving of consideration whether there be not a constant bias in observations of their position, tending ordinarily to place the point assumed as the centre of gravity too near the Sun; in which case positions determined with small telescopes would be most affected, although none would be entirely secure from error.

The same causes which occasion uncertainties in the measurements of the diameter of the nucleus have an equal or greater influence upon the estimates of its brightness. The estimates made with the naked eye include the greater part of the light of the head, and are more strictly comparable with each other than the telescopic estimates, which vary with the power to penetrate towards the true boundary of the nucleus.

The following observations relating to the brightness of the Comet have been collected principally from Section VIII.

Brightness of Nucleus or Head of Comet.

1858.			
June 14.	Vienna, Stampfer	Comet	= 10 magnitude.
15.	Berlin, Bruhns	"	= 11 mag. at the same altitude.
Aug. 14.	Copenhagen	"	= 5 – 6 mag. alt. 14°.
19.	Obs. Harv. Coll.	Nucleus in telescope	= 7 magnitude.
19.	Poulkova, Struve	Comet first visible to naked eye.	

Aug. 23.	Copenhagen	Nucleus (comet to naked eye?) = 4 magnitude.
28.	Berlin, Bruhns	Comet to naked eye = 5 – 6 mag. at the same alt.
29.	Obs. Harv. Coll., Bond	" " = 6 magnitude.
29.	Obs. Harv. Coll., Tuttle	Comet to naked eye as bright as a star of 2 – 3 mag. [?] would have been if seen at the same altitude.
31.	Copenhagen	Comet = 3 – 4 magnitude.
Sept. 2.	Copenhagen	Nucleus in telescope = 3 – 4 "
2.	Berlin, Bruhns	Comet to naked eye = 3 – 4 "
2.	Poulkova, Winnecke	Comet to naked eye much > 46 Fl. or > 4 mag. at the same alt.
2.	Poulkova, Winnecke	Nucleus in comet-seeker > 47 Fl. or > 6 mag. and = 5.4 mag.
2.	Poulkova, Winnecke	Nucleus in comet-seeker much < 46 Fl. or < 4 magnitude.
2.	Poulkova, Winnecke	Comet to naked eye a little < Cor Caroli at the same alt. or < 3 magnitude.
4.	Berlin, Förster	Comet to naked eye = 4 – 5 magnitude.
4.	Albany	" " = 3 "
6.	Berlin, Bruhns	Comet to naked eye nearly = 3 "
6.	Copenhagen	Comet to naked eye? = 3 "
7.	Cambridge, Eng., Breen	Comet to naked eye nearly = 2 "
8.	Obs. Harv. Coll.	Comet to naked eye = 4 "
8.	Obs. Harv. Coll.	Nucleus in telescope = 5 " at the same alt.
10.	Kremsmünster	Comet to naked eye = 3 "
10.	Paris	" " = Brightest stars in the tail of Ursa Major = 2 magnitude.
10.	Paris	Nucleus in telescope < ν Ursæ Majoris or < 3 – 4 magnitude.
10.	Neuchatel	Comet to naked eye = 3 – 4 magnitude.
12.	Obs. Harv. Coll., Bond	" " = 3 "
12.	Obs. Harv. Coll., Bond	Nucleus within diam. of 10″ in telescope = 5 – 6 magnitude.
12.	Obs. Harv. Coll., Hall	Comet to naked eye = 2 magnitude.
12.	Highbury, Eng.	Comet to naked eye but little fainter than the stars of Ursa Major, or a little < 2 magnitude.
12.	Poulkova, Winnecke	Nucleus in comet-seeker = 3.8 mag. or = ξ Ursæ Majoris = 4 – 3 magnitude.
12.	Poulkova, Winnecke	Nucleus in comet-seeker much < ν Ursæ Majoris or < 3 – 4 mag.
13.	Markree	Comet to naked eye? = 3 magnitude.
15.	Berlin, Bruhns	" " = α Ursæ Majoris at $7^h.4$.
16.	Dorpat	" " = 2 magnitude.
16.	Poulkova, Winnecke	Nucleus in comet-seeker = 3.6 mag. or = ν Ursæ Majoris = 3 – 4 magnitude.
16.	Berlin, Bruhns	Comet to naked eye little < α Leonis or < 1 – 2 magnitude.
16.	Dorpat	Comet to naked eye = 2 magnitude.
17.	Obs. Harv. Coll.	" " = 2 "
18.	Poulkova, Struve	Comet to naked eye > α Ursæ Majoris, although at a lower altitude than the star, or > 2 magnitude.

Sept. 18.	Poulkova, Winnecke	Nucleus in comet-seeker?	= 3 – 4 magnitude.
19.	Paris	Nucleus in telescope = companion of Cor Caroli	= 6 – 7 mag.
21.	Cambridge, Eng., Breen	Comet to naked eye	= 1 magnitude.
21.	Highbury, Eng.	" "	> any star of Ursa Major or > 2 magnitude.
21.	Highbury, Eng.	" "	= Procyon nearly = 1 magnitude.
23.	Obs. Harv. Coll.	" "	= 1 magnitude.
23.	Florence	" "	= Mars.
25.	Obs. Harv. Coll.	Nucleus in telescope	= 7 magnitude.
25.	Vienna, Stampfer	$\frac{\text{Nucleus and brightest envelope in telescope}}{\eta \text{ Ursæ Majoris}}$	= 1.25 corrected for atmospheric extinction.
26.	Copenhagen	Comet to naked eye	= Arcturus at the same altitude.
28.	Neuchatel	" "	> Arcturus?
29.	Poulkova, Winnecke	Nucleus in comet-seeker	= 3.7 mag. or < Cor Caroli by $\frac{3}{4}$ of a magnitude.
30.	Poulkova, Winnecke	" " "	> Cor Caroli or < 3 magnitude.
30.	Vienna, Stampfer	$\frac{\text{Nucleus and brightest envelope}}{\eta \text{ Ursæ Majoris}}$	= 0.93.
Oct. 2.	Greenwich, Airy	Comet to naked eye much > Arcturus.	
2.	Obs. Harv. Coll.	Nucleus in telescope	= [2 magnitude.]
2.	Madras	Comet to naked eye	< Arcturus.
2.	Madras	" "	> η Ursæ Majoris or > 2 mag.
3.	Madras	" "	> ε Boötis or > 2 – 3 magnitude.
3.	Madras	" "	> α Coronæ Borealis or > 2 mag.
3.	Madras	" "	< Arcturus or < 1 magnitude.
4.	Madras	" "	= Arcturus nearly.
5.	Greenwich	" "	< Arcturus or < 1 magnitude.
5.	Vienna	Comet to naked eye only a little < Arcturus.	
5.	Oxford, Pogson	By a comparison with the Heliometer $\frac{\text{Arcturus}}{\text{Nucleus in telescope}} = 63.2$, or diff. of mag. = 4.5.	
4 to 6.	Münster	Comet to naked eye at maximum of brightness.	
5.	Obs. Harv. Coll.	Comet at maximum of brightness.	
6.	Obs. Harv. Coll.	Comet to naked eye	= Arcturus nearly.
6 to 8.	Vienna	Comet to naked eye a little	> Arcturus.
6 to 8.	Vienna	Comet to naked eye at maximum of brightness.	
8.	Madras	Comet to naked eye	= Mars or α Lyræ.
10.	Lambayeque to Valparaiso, Bergantin di guerra "Ancud"	" "	= 1 magnitude.
15.	Obs. Harv. Coll.	" "	= 3 "
17.	Berlin, Bruhns	Nucleus in telescope	> 7 "
17.	Neuchatel	Comet to naked eye	= 3 "
19.	Obs. Harv. Coll.	" "	= 3 "

Oct.	19. Obs. Harv. Coll.	Nucleus in telescope = 5 mag., much brighter than B. A. C. 5633, 5709, and 5711, stars of 6 mag. compared with it at the same alt.
	24. Frigate "Novarra"	Comet to naked eye a little $<\beta$ Altaris at the same alt. = 3 magnitude.
	25. Lambayeque to Valparaiso, Bergantin di guerra "Ancud"	Comet to naked eye = 3 magnitude.
	31. Frigate "Novarra"	Comet to naked eye a little $<\beta$ Altaris and = 3 magnitude.
Dec.	4. Santiago	Comet last seen with naked eye.
	9. Rio Janeiro	" " " " = 6 – 7 magnitude.

There is an uncertainty in interpreting many of the above comparisons, from the omission of sufficient explanation as to whether or not the light of the Comet was equal to that of stars of the magnitudes cited, seen at the same altitude above the horizon, and therefore somewhat diminished by the atmospheric absorption. The head of the Comet was always at a low altitude at the time most favorable for observation, commonly between 5° and 15° above the horizon. If we take 10° for its average altitude, the corresponding proportion for the increase of light, to refer it to its zenith-brightness, will be, according to the rate of atmospheric extinction determined by Seidel, 2.53 : 1.00, so that the observed brightness of the Comet must be increased by just one magnitude, for which the light-ratio is 2.51 : 1.00.

On the other hand, if it is intended that the assigned magnitudes should designate the light which the star would afford at the same altitude with the Comet, no correction for extinction will be needed. It is probable that this has been the ordinary practice, because the stars nearest at hand would naturally be used for the comparisons. At the same time, for obvious reasons, the standard stars would usually be somewhat higher than the Comet: on this account, as well as from its being more exposed to the influence of twilight, the tendency has been rather to underrate the light of the Comet.

Where the observations have left the choice between these two conditions undecided, it will be proper to increase the light of the Comet by one half of a magnitude, as an approximate compensation for the influence of atmospheric extinction.

The magnitudes estimated with the telescopes have been further complicated by the use of different magnifying powers and apertures. The greater the optical capacity, the more nearly it would penetrate to the true nucleus, and the more distinctly it would separate from it the surrounding nebulosity. The brightness of the central point would evidently be diminished in proportion as its limits were narrowed. It is impossible to state with any tolerable approximation what

the amount of this reduction would be, although, when the telescopes employed have not differed very greatly in size and power, or when the estimates have been confined to nearly equal areas of the central light of the Comet, the results will be more intelligible.

In the early part of the apparition, it seems that the proportion of light concentrated in the so-called nucleus was very much greater relatively to the surrounding nebulosity than subsequently. For instance, on the 19th of August, the telescopic nucleus comprised about *one third* of the whole light; but some five or six weeks later, when the Comet was near its maximum of brilliancy, the proportion had diminished to *one sixtieth*, or, by some estimates, to as low as *one two-hundred-and-fiftieth* of the light of that part of the head alone which appeared as the nucleus to the naked eye.

This being the case, we may infer from the observations at Vienna and Berlin, cited above, that at the middle of June the whole light of the Comet was equal to that of a star of the 10.5 magnitude, and as this was entirely confined to within a diameter of 2′ or 3′, the result may be properly compared with the subsequent observations made with the naked eye. The estimate at Copenhagen, on Aug. 14th, if it is intended to describe the Comet as having the light of a 5 – 6 magnitude star at the same altitude, will agree with the Poulkova observation on Aug. 19th, when it became visible to the naked eye.

As its most favorable altitude, owing to its nearness to the Sun, could not have then differed much from 10°, we ought to allow a difference of about one magnitude for the effect of extinction; this makes it of the 5th magnitude on Aug. 19th. It was not so recognized elsewhere until about ten or twelve days later, when several observers noticed the fact almost simultaneously; this would bring the date of reaching an effective 6th magnitude, or an actual 5th, to as late as the 30th of August. Combining these with the subsequent observations, we have the following concluded magnitudes, representing the brightness of the "nucleus," as it appeared to the naked eye. In the third column is the quantity of light emitted, corresponding to the magnitude computed by the formula

$$\text{Quantity of light} = R^{m'-m},$$

where $R = 2.512$, $m =$ observed magnitude, and $m' = 5.43 =$ normal magnitude on Aug. 19th, when the Comet was first seen with the naked eye. The fourth column contains the quantity of light emitted, supposing it to vary according to the usual formula proportionally to $\frac{1}{r^2 \Delta^2}$, the unit being the brightness on Aug. 19th.

Observed and Calculated Brightness of the Head of the Comet.

1858.	Observed Magnitude.	Quantity of Light emitted.	$\frac{1}{r^2 \Delta^2}$	1858.	Observed Magnitude.	Quantity of Light emitted.	$\frac{1}{r^2 \Delta^2}$
June 15	10.50	0.0094	0.16	Sept. 27	1.04	57.0	19.92
27	9.86	0.017	0.19	Oct. 1	1.00	59.2	27.84
July 9	9.07	0.035	0.24	5	1.06	56.0	35.68
21	8.15	0.082	0.33	9	1.31	44.5	38.12
Aug. 2	7.11	0.21	0.48	13	1.68	31.6	32.18
14	5.94	0.63	0.79	17	2.20	19.6	22.67
22	5.05	1.42	1.18	25	3.16	8.09	9.50
30	3.89	4.13	1.92	Nov. 2	3.91	4.06	4.28
Sept. 7	2.75	11.8	3.40	10	4.56	2.23	2.20
15	1.82	27.8	6.65	22	5.49	0.95	0.99
19	1.46	38.7	9.49	Dec. 4	6.09	0.54	0.54
23	1.17	50.6	13.78	16	6.55	0.36	0.33

The magnitudes have been corrected, approximately at least, for atmospheric extinction. The maximum of brightness of the head was attained on the 2d of October, when it fell but little short of Arcturus, and was fully of an average first magnitude. This would make it 6300 times brighter than on June 15th, whereas if the light had varied, as is commonly assumed, inversely as the product of the squares of the distances from the Earth and Sun, it would have been only 188 times brighter; the observed brilliancy exceeding the calculated by more than *thirty-three* to *one*. Even this would fall far short of expressing the whole disproportion, if the light given by the tail be also included. That the discordance is not to be ascribed to an erroneous estimate of the magnitude about the middle of June, is evident; for we have good estimates, made independently by two competent observers, and sufficiently accordant. By the formula of the inverse squares of the distances, supposing it to have been of the 1st magnitude on Oct. 2d, we find that it should have been, on June 15th, of the 4.8 magnitude, and therefore plainly visible to the naked eye, which was certainly not the case. The difference between the predicted and the actual brilliancy probably arises from an increase in the aggregate reflecting surface presented by the nebulosity in the vicinity of the nucleus, of which the formula takes no cognizance.

It is interesting to notice that the increase of light went on very rapidly up to the middle of September, when the rate of accumulation was suddenly checked, corresponding in time sufficiently well with the date of the first exhibition of the envelope formation and the beginning of a great development in the density of the tail. A very interesting determination of relative brightness was obtained by

Mr. Pogson at Oxford, by a comparison, made with the heliometer, between Arcturus and the telescopic nucleus, on October 5th, by which it appears that the star gave 62.3 times more light than the nucleus. The result is the more valuable, because just at this time we know that, to the naked eye, the head of the Comet was little if at all inferior to Arcturus.

XII. THE ENVELOPES.

A COMPLETE discussion of the observations upon the envelopes can be made to the best advantage in connection with a theory of their formation which will, in some measure, supply the means of distinguishing the actual phenomena from the errors, illusions, or mere fancies by which they have been so commonly distorted. The figures collected on Plate XLIX. will sufficiently prove that the subject has been exposed to more than ordinary misconception. In many of these drawings, made almost simultaneously by different observers, scarcely a trace of resemblance is left by which it would be known that they are intended to represent the same object. The descriptions and measurements are equally difficult to reconcile, and to get at their full significance will require all the assistance which can be derived from the suggestions and indications of a theory correct at least in its general outlines. There are, however, a few leading features in the envelope-formation which can be distinguished without entering upon a full discussion of all the data, and which may serve as a basis for any future investigation.

The most important of these is the fact of the regular succession of the envelopes, and their continuous ascent from the nucleus; this, if clearly established, supplies a principle of continuity in their history which will be of the greatest service as a means for their identification and for a correct understanding of their changes of aspect. The failure to recognize it on the part of many observers may be readily accounted for, if it is remembered that, in the succession of new envelopes having a general resemblance in form and position to each other, nothing was easier than to confound a later emission with its predecessor, when, from cloudy weather or any other cause, the observations have been interrupted for a length of time, so that the connection of the phenomena has been lost.

The following is a collection of observed distances of the vertex of each envelope

from the nucleus, reduced to the epoch 7^h m. s. t. at the Observatory of Harvard College. The notation and order of succession have been adopted from p. 199. The distances of the vertex are denoted by $n a'$, $n b'$, &c. for the envelopes A, B, &c.

In many instances, where the means of supplying the scale of the drawings have been at hand, they have been used to furnish the numbers. Differences which will be noticed between the micrometer measurements of Section VIII. and the distances here adopted are owing to this circumstance, the indications of the figures having been combined with the direct measurements. In some cases, where only the breadths of the envelopes have been measured, the vertical distances have been constructed with the aid of the figures. Doubtful results, or such as are least reliable, are indicated by affixing a note of interrogation, or by enclosing them in parentheses.

Observatory of Harvard College.

Distances of the Vertices of the Envelopes at 7^h m. s. t.

	$n a'$	$n b'$	$n c'$	$n d'$	$n e'$	$n f'$	$n g$
	″	″	″	″	″	″	″
Sept. 20	(22.5)	(3.0)	....	....	....	....	....
23	28.5	13.5	....	....	....	....	....
24	32.6	14.1	4.4	....	....	....	....
25	(45.0)	18.1	6.2	....	....	....	....
27	....	22.5	7.1	....	....	....	....
29	(55.0)	33.0	16.6	....	....	....	....
30	....	....	(17.0)	....	....	....	....
Oct. 2	....	45.3	25.6	....	....	....	....
4	....	....	32.0	10.6	....	....	....
5	....	(52.5)	35.4	15.6	....	....	....
6	....	(48.8)	38.2	17.8	....	....	....
8	....	(56.0)	48.5	28.0	....	....	....
9	....	....	52.1	34.5	7.6	....	....
10	....	....	55.9	36.6	11.1	....	....
11	....	....	(54.0)	(41.7)	19.3	....	....
15	....	....	....	(41.0)	29.7	10.6	....
18	....	....	....	(38.0)	31.2	14.9	....
19	....	....	....	....	33.8	(16.3)	....
20	....	....	....	....	....	(22.0)	(3.0)

The gradual elevation of the envelopes was here noticed early in the series, so that their identification has given little or no difficulty, excepting in the case of A, upon which the observations are less reliable than for the rest, and leave the question of identity somewhat unsettled.

The apparent formation of the earliest envelopes, as though by a deposition like

that of vapor, rather than by elevation from the nucleus, has been noticed in Section VIII., and may have something to do with the difficulty of tracing the history of *A*.

The numbers which we shall next consider have been derived from the observations made at Poulkova by Struve. They depend partly upon micrometer measurements, and partly upon the distances measured from the lithographs, with the scales attached to each, the mean of the two having been generally adopted. The series is particularly valuable on account of the superior optical power of the telescope, and from the security against misapprehension of the observations which is afforded by the lithographic illustrations accompanying them. The interruptions between the observations occurred so as to prevent the substitution of the envelopes from being perceived. Thus on Sept. 24th, *A* and *B* were observed. By the next date, Sept. 29th, the elevation of *B* had brought it nearly into the position occupied by *A* on Sept. 24th, and *C* had taken the place of *B*. Again, on Oct. 5th, *C* was in the position of *B* on Sept. 30th, or nearly enough so to be mistaken for it; and *D* had been substituted for *C*. On the 9th, *E*, at the time of observation, had not left the surface of the nucleus, or was not distinguishable from it, and on the 13th, *D* and *E* occupied the positions of *C* and *D* respectively on the 7th. Under these circumstances, it would scarcely have been possible to recognize the regular ascent of the envelopes. We shall find, however, by admitting the above substitutions, that the observations are consistent with each other and with the series made at the Observatory of Harvard College.

The reductions to the common epoch 7^h m. s. t. Obs. Harv. Coll. have required the addition to the observed distances of small corrections for motion in the interval varying from $0''.7$ to $1''.2$. The results are given below, classed, as in the original, under the headings of "Fächer" for the inner envelope, and "Halbbogen" for the outer. I have affixed to each result its proper designation in conformity with the notation above proposed.

POULKOVA, — STRUVE.

Distances of the Vertices of the Envelopes reduced to 7^h *m. s. t. Obs. Harv. Coll.*

	Fächer.	Halbbogen.
Sept. 24	$nb' = 14''.5$	$na' = 27''.0$
29	$nc' = 16.8$	$nb' = 28.2$
30	$nc' = 14.8$	$nb' = 30.9$
Oct. 5	$nd' = 17.2$	$nc' = 38.9$
7	$nd' = 22.6$	$nc' = 44.4$
9	$nd' = 31.1$	$nc' = 47.9$
13	$ne' = 20.7$	$nd' = 42.1$

The following are the results of observations made at Poulkova, by Winnecke, with the heliometer. In applying the notation, considerable uncertainty has arisen with reference to the outer sector, as was to have been anticipated from its being much the fainter of the two. The date Sept. 24, on p. 45 of the published account, has been changed to Sept. 29th, to conform with the statement on p. 24 of the published account.

POULKOVA, — WINNECKE.

Distances of the Vertices of the Envelopes reduced to 7^h *m. s. t. Obs. Harv. Coll.*

	Innerer Sector.	Äusserer Sector.
Sept. 24	$n\,b' = 16''.9$	$n\,a' = 35''.2$
25	$n\,b' = 19.9$	....
29	$n\,c' = 12.7$	$n\,b' = 27.4$
30	$n\,c' = 15.3$	$n\,b' = 27.2$
Oct. 5	$n\,d' = 15.0$	$n\,c' = 32.4$
7	$n\,d' = 22.2$	$n\,c' = 39.8$
8	$n\,d' = 24.5$	? = 38.3
9	$n\,d' = 30.2$	? = 40.5
13	$n\,e' = 19.1$	? = 35.6

From the Dorpat observations we derive the following. There are considerable discrepancies among the individual measurements on October 7th and 9th.

DORPAT.

Distances of the Vertices of the Envelopes reduced to 7^h *m. s. t. Obs. Harv. Coll.*

Sept. 25	$n\,b' = 18''.2$	Sept. 29	$n\,c' = 17''.5$	Oct. 6	$n\,d' = 28''.0$	Oct. 12	$n\,e' = 17''.4$
26	$n\,b' = 20.8$	30	$n\,c' = 15.3$	7	$n\,d' = (24.1)$	13	$n\,e' = 17.0$
27	$n\,b' = 22.4$	Oct. 2	$n\,c' = 27.4$	8	$n\,d' = (23.7)$	14	$n\,e' = 22.2$
29	$n\,b' = 32.3$			9	$n\,d' = (27.4)$		
30	$n\,b' = 34.5$						

The remaining observations will be included, without further comment, in the following statement. In many instances, the identification is by no means certain, and the notation has been inserted by way of suggestion merely; the discrepancies do not appear to admit of explanation excepting as errors or misapprehensions. The distances have been reduced to the same epoch with the rest.

Altona.

Sept. 28 nb' ? $= 35''.9$	Sept. 28 $nc' = 15''.8$	Oct. 8 $nd' = 31''.0$	Oct. 11 $ne' = 15''.6$
Oct. 1 $nb' = 35.9$	Oct. 1 ? $= 14.3$	9 $nd' = 34.0$	
3 $nb' = 40.8$	3 ? $= 16.0$	10 $nd' = 35.9$	16 $nf' = 18.0$
5 $nb' = 43.2$	5 $nc' = 26.0$		
6 $nb' = 43.3$	6 $nc' = 31.0$		
	9 $nc' = 45.7$		

Berlin.

Oct. 4 $nb' = 40''.8$	Oct. 4 nd' ? $= 16''.9$
	6 $nd' = 16.0$
	7 $nd' = 17.0$
	8 $nd' = 19.1$

Geneva.

Oct. 6 $nd' = (31''.0)$	Oct. 13 $ne' = (29''.7)$
	14 $ne' = (26.6)$

Greenwich.

Oct. 9 $nd' = 38''.9$	Oct. 9 $ne' = 16''.6$	Oct. 16 $nf' = 16''.5$
11 $nd' = 42.9$	11 $ne' = 26.6$	
	15 $ne' = 34.6$	

Cambridge, England.

Oct. 13 $nd' = (44''.9)$	Oct. 15 $ne' = (32''.5)$	Oct. 15 $nf' = (11''.4)$
	16 $ne' = (34.5)$	16 $nf' = (15.4)$

Bradstones.

Oct. 3 nc' ? $= (37''.6)$	Oct. 3 $nd' = (11''.7)$
4 $nc' = (30.1)$	4 $nd' = (13.9)$

Rome.

Sept. 29 $nb' = 24''.8$	Oct. 14 $nd' = 40''.4$	Oct. 15 $nf' = 15''.6$
		17 $nf' = 21.7$
		18 $nf' = 23.7$

Florence.

Oct. 3 $nc' = 31''.2$	Oct. 3 $nd' = (\ 4''.8)$	Oct. 16 $nf' = 10''.9$
	7 $nd' = (15.0)$	
	8 $nd' = (17.0)$	

Christiania.

Oct. 15 $nd' = 38''.0$

Paris.

Oct. 15 $nf' = 11''.7$

Leyden.

Oct. 11 nd' ? $= 48''.6$ Oct. 11 $ne' = 24''.2$

Cape of Good Hope.

Oct. 23 $ng' = 15''.0$

The observations by Schmidt at Vienna cannot be reconciled with the rest of the measurements, and will require explanation before they can be used in combination with them. They have accordingly been omitted.

To compare the individual observations, we will now bring together under one view all those identified as probably belonging to the same envelope.

Distances from Nucleus to Vertex.

Envelope A.

	Observatory Harv. Coll.	Poulkova. Struve.	Poulkova. Winnecke.
	″	″	″
Sept. 20	(22.5)	....	....
23	28.5	....	....
24	32.6	27.0	35.2
25	(45.0)	....	....
29	(55.0)	....	....

Envelope B.

	Observatory Harv. Coll.	Poulkova. Struve.	Poulkova. Winnecke.	Dorpat.	Berlin.	Altona.	Rome.
	″	″	″	″	″	″	″
Sept. 20	(3.0)	....	....	....	....	....	....
23	13.5	....	....	....	....	....	....
24	14.1	14.5	16.9	....	....	....	....
25	18.1	....	19.9	18.2	....	....	....
26	....	....	....	20.8	....	....	....
27	22.5	....	....	22.4	....	....	....
28	....	....	....	....	....	35.9 ?	24.8
29	33.0	28.2	27.4	32.3	....	....	....
30	....	30.9	27.2	34.5	....	....	....
Oct. 1	....	....	....	....	....	35.9	....
2	45.3	....	....	....	....	....	....
3	....	....	....	....	....	40.8	....
4	....	....	....	....	40.8 ?	....	....
5	(52.5)	....	....	....	....	43.2 ?	....
6	(48.8)	....	....	....	....	....	....
8	(56.0)	....	....	....	....	43.3 ?	....

Envelope C.

	Observatory Harv. Coll.	Poulkova. Struve.	Poulkova. Winnecke.	Dorpat.	Altona.	Bradstones.	Florence.
	″	″	″	″	″	″	″
Sept. 24	4.4	....	....	....	....	....	....
25	6.2	....	....	....	....	....	....
27	7.1	....	....	....	....	....	....
28	....	....	....	....	15.8	....	....
29	16.6	16.8	12.7	17.5	....	....	....
30	(17.0)	14.8	15.3	15.3	....	....	....
Oct. 1	....	....	....	....	14.3 ?	....	....
2	25.6	....	....	27.4	....	....	....
3	....	....	....	....	16.0 ?	37.6 ?	31.2
4	32.0	....	....	....	....	(30.1)	....

		Observatory Harv. Coll.	Poulkova. Struve.	Poulkova. Winnecke.	Dorpat.	Altona.	Bradstones.	Florence.
		″	″	″	″	″	″	″
Oct.	5	35.4	38.9	32.4	....	26.0 ?	....	....
	6	38.2	....	....	....	31.0 ?	....	....
	7	....	44.4	39.8	....	....	....	....
	8	48.5	....	....	....	....	....	....
	9	52.1	47.9	....	....	45.7	....	....
	10	55.9	....	....	....	....	....	....
	11	(54.0)	....	....	....	....	....	....

Envelope D.

		Observatory Harv. Coll.	Poulkova. Struve.	Poulkova. Winnecke.	Dorpat.	Altona.	Berlin.	Greenwich.	Cambridge, Eng.	Bradstones.	Rome.	Florence.
		″	″	″	″	″	″	″	″	″	″	″
Oct.	3	....	....	....	....	....	....	....	....	(11.7)	....	(4.8)
	4	10.6	....	....	....	....	16.9	....	....	(13.9)	....	....
	5	15.6	17.5	15.0	....	....	....	....	....	....	....	....
	6	17.8	....	....	28.0	....	16.0	....	....	....	....	....
	7	....	22.6	22.2	(24.1)	....	17.0 ?	....	....	....	....	(15.0) ?
	8	28.0	....	24.5	(23.7)	31.0	19.1 ?	....	....	....	....	(17.0) ?
	9	34.5	31.1	30.2	(27.4)	34.0	....	38.9 ?	....	....	....	....
	10	36.6	....	....	....	35.9	....	....	....	....	....	....
	11	(41.7)	....	....	....	....	....	42.9	....	....	....	....
	13	....	42.1	....	....	....	....	....	(44.9)	....	....	....
	14	....	....	....	....	....	....	....	....	....	40.4	....
	15	(41.0)	....	....	....	....	....	....	....	....	....	....
	18	(38.0)	....	....	....	....	....	....	....	....	....	....

At Geneva	Oct. 6	$nd' =$	31″.0 ?
" Leyden	11	$nd' =$	48.6
" Christiania	15	$nd' =$	38.0

Envelope E.

		Observatory Harv. Coll.	Poulkova. Struve.	Poulkova. Winnecke.	Dorpat.	Altona.	Greenwich.	Cambridge, Eng.	Geneva.	Leyden.
		″	″	″	″	″	″	″	″	″
Oct.	9	7.6	....	....	....	....	16.6 ?	....	....	....
	10	11.1	....	....	....	....	....	....	....	....
	11	19.3	....	....	....	15.6	26.6 ?	....	....	24.2
	12	....	....	....	17.4	....	....	....	....	....
	13	....	20.7	19.1	17.0	....	....	....	(29.7)	....
	14	....	....	....	22.2	....	....	....	(26.6)	....
	15	29.7	....	....	....	....	34.6	(32.5)	....	....
	16	....	....	....	....	....	....	(34.5)	....	....
	18	31.2	....	....	....	....	....	....	....	....
	19	33.8	....	....	....	....	....	....	....	....

Envelope F.

		Observatory Harv. Coll.	Altona.	Greenwich.	Cambridge, Eng.	Rome.	Paris.	Florence.
		″	″	″	″	″	″	″
Oct.	15	10.6	....	....	(11.4)	15.6	11.7	....
	16	....	18.0	16.5	(15.4)	....	....	10.9
	17	....	....	....	....	21.7	....	....
	18	14.9	....	....	....	23.7	....	....
	19	(16.3)	....	....	....	....	....	....
	20	(22.0)	....	....	....	....	....	....

Envelope G.

		Observatory Harv. Coll.	Cape of Good Hope.
		″	″
Oct.	20	3.0	....
	23	....	15.0

The following normal values have been derived from the above by a graphical projection, giving, with a few modifications in exceptional cases, a relative weight of 4 to the numbers obtained with the large refractors at the Observatory of Harvard College and at Poulkova by Struve, — a weight of 2 to the observations at Poulkova by Winnecke and at Dorpat, — and of 1 to all the rest. The epoch is, as before, 7^h m. s. t. at the Observatory of Harvard College. The numbers enclosed in parentheses have been extrapolated beyond the dates of observation.

Normal Distances of the Apex of the Envelopes from the Nucleus.

1858.		A.	B.	C.	D.	E.	F.	G.
		″	″	″	″	″	″	″
Sept.	16	(1.2)	....	....	....	....	....	....
	17	(5.0)	....	....	....	....	....	....
	18	(8.6)	....	....	....	....	....	....
	19	(12.1)	(0.0)	....	....	....	....	....
	20	15.7	3.0	....	....	....	....	....
	21	19.3	6.0	....	....	....	....	....
	22	23.3	8.9	....	....	....	....	....
	23	27.9	12.0	(2.2)	....	....	....	....
	24	32.8	14.8	3.7	....	....	....	....
	25	38.2	18.0	5.6	....	....	....	....
	26	43.6	20.9	7.7	....	....	....	....
	27	48.2	23.9	10.0	....	....	....	....
	28	52.5	26.7	12.6	....	....	....	....
	29	56.0	29.8	15.4	....	....	....	....
	30	(58.5)	33.2	18.4	....	....	....	....

	A.	B.	C.	D.	E.	F.	G.
	″	″	″	″	″	″	″
Oct. 1	....	36.6	21.8	(1.2)	....	....	....
2	....	40.2	25.2	(4.8)	....	....	....
3	....	43.7	28.8	8.4	....	....	....
4	....	46.9	32.3	12.1	....	....	....
5	....	49.8	35.9	16.0	....	....	....
6	....	52.5	39.5	19.4	....	....	....
7	....	54.6	43.2	22.4	....	....	....
8	....	55.9	46.8	26.2	(2.8)	....	....
9	....	....	50.3	30.8	7.4	....	....
10	....	....	53.8	36.3	11.7	(1.9)	....
11	....	....	57.1	40.4	15.6	(4.0)	....
12	....	....	....	42.5	19.2	(5.9)	....
13	....	....	....	43.1	22.5	(7.9)	....
14	....	....	....	42.8	25.7	(9.9)	....
15	....	....	....	41.9	28.7	11.9	....
16	...	....	....	40.7	31.1	13.9	....
17	....	....	....	39.4	32.9	15.8	....
18	....	....	....	38.0	34.1	17.9	....
19	....	....	....	....	34.6	19.8	....
20	....	....	....	....	....	21.8	3.0
21	....	....	....	....	....	(23.7)	7.0
22	....	....	....	....	....	....	11.0
23	....	....	....	....	....	....	15.0

Comparing the above with the original observations, we shall find that the probable error of a determination of the vertical distance of an envelope, taking the numbers indiscriminately without regard to weights, is 2″.1. It may be worth while to inquire how near an agreement would have been effected, under the same method of treatment, between the observations and the hypothesis of a continuous ascent of the envelopes, if the hypothesis had been erroneous and the envelopes had really occupied positions scattered at random, and with equal frequency at all distances from the nucleus between the limits which comprise the range of observation. In this case the probable deviation of an observation would have been about 5″; that actually found being only 2″.1, which is not larger than we may with safety attribute to the casual errors of observation.

To find the actual rate of ascent, the observed distances must be corrected to the unit of distance of the Comet from the Earth. The correction for the influence

of perspective on the outline due to the inclination of the principal axis to the line of sight, will be neglected; it is probably quite small, since the surface of the envelopes near the vertex was very nearly spherical, with the centre not far from the nucleus, and would therefore be but little altered by projection; and the principal axis, if, as is most likely, it was directed towards the Sun, was inclined by only small angles to the plane of projection, the value of $n = \cos. \nu$ varying only between 0.89 and 1.00 during the whole interval.

The following are the elevations of the envelopes above the nucleus, reduced to the unit of distance from the Earth.

Normal Distances of the Apex of the Envelopes from the Nucleus.

(*Reduced to the Unit of Distance from the Earth.*)

	A.	B.	C.	D.	E.	F.	G.
	″	″	″	″	″	″	″
Sept. 16	(1.4)	....	....	....	....	....	....
17	(5.6)	....	....	....	....	....	....
18	(9.4)	....	....	....	....	....	....
19	(12.8)	(0.0)	....	....	....	....	....
20	16.2	3.1	....	....	....	....	....
21	19.1	5.9	....	....	....	....	....
22	22.2	8.5	....	....	....	....	....
23	25.7	11.1	(2.0)	....	....	....	....
24	29.1	13.2	3.3	....	....	....	....
25	32.7	15.3	4.8	....	....	....	....
26	35.8	17.2	6.3	....	....	....	....
27	38.0	18.9	7.9	....	....	....	....
28	39.7	20.2	9.5	....	....	....	....
29	40.1	21.7	11.2	....	....	....	....
30	(40.9)	23.2	12.9	....	....	....	....
Oct. 1	....	24.5	14.6	(0.8)	....	....	....
2	....	25.8	16.2	(3.1)	....	....	....
3	....	27.1	17.9	5.2	....	....	....
4	....	28.1	19.4	7.2	....	....	....
5	....	28.9	20.8	9.3	....	....	....
6	....	29.7	22.3	10.9	....	....	....
7	....	30.2	23.8	12.3	....	....	....
8	....	30.3	25.5	14.2	(1.5)	....	....
9	....	....	27.2	16.6	4.0	....	....

	A.	B.	C.	D.	E.	F.	G.
	"	"	"	"	"	"	"
Oct. 10	....	....	29.1	19.5	6.3	(1.0)	....
11	....	....	30.8	21.8	8.4	(2.2)	....
12	....	....	....	23.1	10.5	(3.2)	....
13	....	....	....	23.9	12.5	(4.4)	....
14	....	....	....	24.1	14.5	(5.6)	....
15	....	....	....	24.3	16.7	6.9	....
16	....	....	....	24.4	18.7	8.3	....
17	....	....	....	24.4	20.4	9.8	....
18	....	....	....	24.4	21.9	11.5	....
19	....	....	....	....	23.0	13.1	....
20	....	....	....	....	....	15.0	2.1
21	....	....	....	....	....	(17.0)	5.0
22	....	....	....	....	....	....	8.2
23	....	....	....	....	....	....	11.6

In several instances there is a tendency to a diminished rate of ascent at the larger elevations, although it is to be noticed that for *C*, which is one of the best determined of the series, the elevation-velocity is sensibly uniform. As elsewhere remarked, the vertices of the envelopes, originally brighter and better defined than other parts of the outline, were the first to be dissipated. The later observations upon them were therefore particularly liable to error. The question of a change in the rate of expansion of the envelopes will be better considered from a comparison of their breadths at the parallel of the nucleus, where they remained in sight considerably longer.

By referring to Plates XXXIX., XL., XLI., and XLII., drawn from sketches made at the Observatory of Harvard College, in which particular attention was given to this point, it will be seen that the alternations of light and shade are more compressed as we go outward from the nucleus. This can be explained in three ways: —

1. The elevation-velocity of the envelopes which first appeared may have been less than that of their successors, causing the latter to overtake them.

2. The intervals between two envelopes may have been originally less between *A* and *B* than between *B* and *C*, and similarly for the others, each rising higher than its predecessor before being succeeded by a new one.

3. The rate of expansion may have changed.

For *A*, *B*, *C*, *D*, and *E*, which, with the exception of *A*, are the ones best

determined, as well as those with which we are at present most concerned, we find the following velocities of elevation.

To guard against any influence from a change of velocity in the same envelope, we will ascertain the velocities for *B, C, D,* and *E,* by choosing for the extreme dates those on which each reached the height of 6″ and 22″ at the unit of distance. In the case of *A* this could not be done, as it was not seen until it had attained a considerable elevation. An interval of eight days from the earliest date was therefore used for determining its rate of elevation.

Daily Rate of Elevation of the Vertex of the Envelopes.

(Reduced to the Unit of Distance from the Earth.)

For *A*	Sept. 20 to Sept. 28	$n\,a' = 28''$	Daily Elevation	$+2''.94$
B	" 21 " " 29	$n\,b' = 14$	" "	$+1.98$
C	" 26 " Oct. 6	$n\,c' = 14$	" "	$+1.60$
D	Oct. 3 " " 11	$n\,d' = 14$	" "	$+2.08$
E	" 10 " " 18	$n\,e' = 14$	" "	$+1.95$

The differences between these numbers may, to a considerable extent, if not entirely, be referred to errors of observation. As they stand, they give no indication of the cause of the compression of the envelopes. The only large differences occur in *A* and *C*, but in both cases the effect of the difference of velocity would have been to increase the distances of the outer envelopes, instead of diminishing them.

With regard to the second hypothesis, we find for the reduced distance of the envelope *A* from *B*, at the time when *B* first appeared, that of *B* from *C* when *C* first appeared, and similarly for the rest:—

Original Distances of the Envelopes apart at the Vertex.

(Reduced to the Unit of Distance from the Earth.)

Sept. 20	$n\,a' - n\,b' = 13''.1$
" 24	$n\,b' - n\,c' = 9.9$
Oct. 3	$n\,c' - n\,d' = 12.7$
" 9	$n\,d' - n\,e' = 12.6$
" 15	$n\,e' - n\,f' = 9.8$
" 20	$n\,f' - n\,g' = 12.9$

It is evident that the original disposition as here ascertained gives no support to the second of the proposed explanations.

According to the above distances and daily velocities, supposing the ascent to

be uniform, the reduced distances on Oct. 9th, when the relation of the envelopes was ascertained with particular care, should have been

$$n a' - n b' = 31''.3$$
$$n b' - n c' = 15.6$$
$$n c' - n d' = 9.8$$
$$n d' - n e' = 12.6$$

On this date, the vertices of A and of B were too faint to be recognized, but the portions of them remaining on either side of the nucleus sufficiently indicate that the curves, if continued round to the apex, would give values of $(n a' - n b')$, $(n b' - n c')$, &c., regularly decreasing in proceeding inward towards the nucleus, and not at all in accordance with the numbers here deduced, on the hypothesis of a uniform ascent.

To illustrate more fully the variation in the rate of expansion, the following breadths of the envelope B, at the parallel of the nucleus, have been derived from drawings and measurements made at the Observatory of Harvard College. In general, owing to the faintness of the outlines, the proportions of the drawings are the most to be depended upon. B has been selected, particularly, on account of its embracing a longer range of reliable observations than the others, which, in the present discussion, is a condition of particular importance.

Breadths of the Envelope B at the Parallel of the Nucleus at 7^h *m. s. t. Obs. Harv. Coll.*

Sept. 23	$b b'' = 24''$		Oct. 5	$b b'' = (150'')$	
24	$= 35$		6	$= 138$	
25	$= 42$		8	$= 152$	
27	$= 54$		9	$= 151$	
29	$= 81$		10	$= 161$	
Oct. 2	$= 108$		11	$= 156$	
4	$= (129)$				

The following normal values have been constructed from the above, giving only half weight to the mean of the results for Oct. 4th and 5th, which rest upon uncertain data. The numbers enclosed in parentheses belong to dates outside of the earliest or latest observations, having been extrapolated, following the general tenor of the differences; they have, of course, no independent value.

Normal Breadths of the Envelope B at the Parallel of the Nucleus at 7^h *m. s. t. Obs. Harv. Coll.*

Sept. 20	$bb'' =$ (2″.2)	Oct. 2	110″.5
21	(9.5)	3	119.7
22	(17.0)	4	128.1
23	24.7	5	134.9
24	32.8	6	140.6
25	40.9	7	145.4
26	49.0	8	150.0
27	58.3	9	153.5
28	68.1	10	156.8
29	78.8	11	159.6
30	89.7	12	(161.2)
Oct. 1	100.5		

The general agreement of the data is very good; no deviation larger than 4″ occurring in any one instance, excepting on Oct. 5th, when the observation is quite uncertain.

Reduced to the unit of distance from the Earth, the normal breadths become as follows: —

Normal Breadths of the Envelope B at the Parallel of the Nucleus at 7^h *m. s. t. Obs. Harv. Coll.*

(Reduced to the Unit of Distance from the Earth.)

		Diff.			Diff.
Sept. 20	$bb'' =$ (2″.3)	7″.1	Oct. 1	$bb'' =$ 67″.3	3″.9
21	(9.4)	6.8	2	71.2	3.1
22	(16.2)	6.6	3	74.3	2.5
23	22.8	6.3	4	76.8	1.6
24	29.1	5.9	5	78.4	1.1
25	35.0	5.3	6	79.5	1.0
26	40.3	5.7	7	80.5	1.2
27	46.0	5.6	8	81.7	1.1
28	51.6	5.7	9	82.8	1.6
29	57.3	5.3	10	84.4	1.9
30	62.6	4.7	11	86.3	1.8
Oct. 1	67.3		12	(88.1)	

The course of the differences confirms the indications before obtained from the distances of the vertices of the envelopes, and fully establishes the variation in the rate of expansion in proceeding outward from the nucleus. We may add, that a similar result is given by the breadths of the other envelopes, although the observations are not so complete.

To find the interval between the detachment of the successive envelopes, we have the following interpolated epochs at which they reached the distance 12″ from the nucleus, reduced to the unit of distance from the Earth.

Intervals between Successive Envelopes.

A	$\Delta \times na' = 12''.0$	Sept. 19	1ʰ	m. s. t.	Obs.	Harv. Coll.		
B	" $nb' = 12.0$	23	17	"	"	"	Interval =	4ᵈ 16ʰ
C	" $nc' = 12.0$	29	18	"	"	"		6 1
D	" $nd' = 12.0$	Oct. 7	2	"	"	"		7 8
E	" $ne' = 12.0$	13	1	"	"	"		5 23
F	" $nf' = 12.0$	18	15	"	"	"		5 14
G	" $ng' = 12.0$	23	10	"	"	"		4 19

The peculiar forms assumed by the envelopes will best be understood from the engravings, Plates XXVIII. to XLVI., and Plate XLIX.* A large number of the figures on the latter Plate continue the circular outlines below the parallel of the nucleus; this, however, is certainly an illusion on the part of the observer. In a completely formed envelope, the outline was very nearly circular for about 60° or 80° on either side of the vertex; below the nucleus the two branches diverged from each other, taking a direction nearly coincident with that of the branches of the tail; not, however, precisely so, for the asymptotes to the envelope-curve were inclined to each other by an angle sensibly smaller than that including the branches of the tail. The latter were, in fact, as has been pointed out before, *penetrated* by the envelopes, and it may have been an attempt to represent this peculiarity, indistinctly seen, which has led to the distortion referred to.

At their first appearance they exhibited a considerable variety in figure, as may be seen more particularly in the engravings, Plates XXXI., XXXII., XXXVI., XXXVII., and XLIII., XLIV. Their boundary, on the side opposite to the sun, although less clearly defined than at the vertex, seemed for one or two days to remain still a closed surface, here and there penetrated by streams of nebulous material escaping into the tail. This took place at first mostly at the two cusps. As the envelope expanded, the discharge became more general, but always from the sides, until the outline assumed the normal form above described; at the same time, the irregular accumulations of nebulosity and the jets radiating outwards from the nucleus, with which its surface was originally diversified, were gradually diffused; the whole acquiring greater evenness and symmetry. The vertex, at first the brightest and best defined part of the circumference, now began to fade out, and at last entirely disappeared, while the sides remained still visible, intersecting, or rather penetrating, the branches of the tail for a short distance below the nucleus.

* It is interesting to notice among these representations peculiarities which may serve to explain, with due allowance for defective drawing, some of the features in ancient figures Compare, for instance, Fig. 132 of Plate XLIX. with the figure of Halley's Comet in 1682, given by Hevelius.

The appearance of a new envelope seems to have been preceded by a cessation of action on the surface of the nucleus, for a dark interval was always interposed between it and its predecessor. It deserves particular notice, that, on the earliest occasion of the recognition of the envelope formation, it was this dark arc which first attracted attention. After an envelope had acquired a little development, it appeared bordered by a brighter rim just within the dark band, the two together forming by their contrast a clear line of separation. This alternation of light and shade gave a peculiar aspect to the telescopic view between the 5th and the 11th of October, when three, and sometimes four or five envelopes, or portions of them, could be distinguished at one view. Traces of *A* are indicated near and below the parallel of the nucleus as late as Oct. 9th, and of *B* up to the 10th and 11th, and, but for the moonlight and the unfavorable position of the Comet, they might perhaps have been discerned still later. The fact is very singular, showing, as it does, that some portions of the nebulosity evolved from the nucleus, probably as early as the 23d of September, continued in its vicinity for at least eighteen days later. The date here assumed as the latest on which *B* received any fresh accession of material, is that of the first appearance of *C*, before which time the connection of *B* with the nucleus had been finally severed by the process just described.

For an illustration of the progress of an envelope through its different stages, Plates XXXVI., XXXVII., and XXXIX. may be compared; in the latter, it has reached very nearly its full development. Plate XXXI. gives perhaps as good a representation as any of a completely formed envelope, surrounded by its dark arc. On Plate LI. is a representation of an inner, middle, and outer envelope, seen in the Comet 1860, III. with the great refractor of the Observatory of Harvard College.

One of the most interesting of the phenomena presented in the telescopic aspect of the Comet was the appearance of a dark spot and a so-called secondary nucleus on the envelope *D* in the early part of October. The spot was first seen on the 3d, when the envelope had as yet barely detached itself from the nucleus, appearing as a dark or almost black opening, with clearly marked outlines, and equal in size with the nucleus, from which it was distant about 5″ of arc. That it should have been visible at all in such a position shows it to have had a very decided character.

The general attention attracted to it appears in the numerous descriptions of its position and aspect for the ensuing eight or ten days, which furnish materials for several important inferences respecting the constitution of the envelopes.

Among these is an entirely unexceptionable confirmation of the fact of the gradual elevation of the envelopes; for the occurrence of so characteristic a feature has left no possibility of mistaking the identity of the envelope *D* through its earlier stages, nor of deception as to the reality of the motion from night to night. More important, because much more difficult to establish from other data, is the conclusion, strongly indicated by the observations, that the envelopes retain a certain degree of permanence in their internal distribution for a long interval after their first emission.

The evidence also goes strongly to prove that the motion of rotation of the envelope about the principal axis was too small to be detected in an interval of eight or ten days.

The following positions of the spot on *D*, referred to the nucleus, have been derived from micrometer measurements, or from figures of the Comet. The latter in general furnish results quite as reliable as any which could be obtained by instrumental means.

The later observations are of course liable to considerable uncertainty, owing to the expansion of the opening over a large area without definite limits; there may be also occasional discrepancies which have arisen from the intersection of the spot by a bright jet or collection of light matter, by which it was divided into two parts, not always clearly distinguishable from each other. I have endeavored to give the centre of the general deficiency of light without regarding the division.

Positions of the Dark Spot in D.

p = angle of position of the axis of the tail.
p' = " " " spot.

Oct. 3	Greenwich, Christy	$p'-p = 230^\circ$	
3	Munich, Lamont	" $= 220$	
3	York, Gray	Spot seen on the preceding side of the nucleus.	
4	Obs. Harv. Coll., Bond	$p'-p = 249^\circ$	Distance $= 6''.3$, about $\frac{6}{10}$ dist. to edge of envelope.
4	Obs. Harv. Coll., Bond	" $= 239$	
4	Berlin, Bruhns	" $= 242$	
4	Greenwich, Christy	" $= 233$	
4	Munich, Lamont	" $= 230$	
4	Bradstones, Lassell	" $= 300$	
5	Obs. Harv. Coll., Bond	" $= 239$	Distance $= 10''$
5	Obs. Harv. Coll., Bond	" $= 222$	" $= 10$
5	Bradstones, Lassell	" $= 268$	" $= \frac{7}{10}$ radius of envelope.
5	Haddenham, Dawes	" $= 239$	" $= \frac{7}{10}$ " "

Oct. 5	Markree, Graham	$p' - p = 230^\circ$	
5	Greenwich, Christy	" $= 225$	
5	Cambridge, Challis	" $= 235$	Dark and bright spots.
5	Berlin, Bruhns	" $= 229$	
5	Poulkova, Winnecke	" $= 233$	
6	Obs. Harv. Coll., Bond	" $= 224$	
6	Obs. Harv. Coll., Bond	" $= 221$	
6	Cambridge, Challis	" $= 245$	Dark and bright spots.
6	Berlin, Bruhns	" $= 207$	
7	Obs. Hamilton Coll., Peters	" $= 233$	
7	Dorpat, Mädler	" $= 219$	
7	Poulkova, Winnecke	" $= 240$ *	
8	Obs. Harv. Coll., Bond	" $= 226$	Distance $= 14''.2$
8	Obs. Harv. Coll., Fette	" $= 226$	" $= 19.3$
8	Bradstones, Lassell	Traces of the spot remaining.	
8	Haddenham, Dawes	$p' - p = 225^\circ$	General deficiency of light in this direction.
8	Cambridge, Challis	" $= 240$	Dark and bright spots.
8	Poulkova, Winnecke	" $= 240$	
9	Obs. Harv. Coll., Fette	" $= 227$	
9	Ann Arbor, Brünnow	" $= 235$	
9	Poulkova, Winnecke	" $= 239$	
10	Obs. Harv. Coll., Fette	" $= 230$	
11	Obs. Harv. Coll., Fette	" $= 205$	Distance $\frac{7}{10}$ to edge of envelope, with general deficiency of light to 180°?
12	Paris, Chacornac	Direction of spot not changed.	
13	Poulkova, Winnecke	Dark spot still thought to be in sight on the left side.	
15	Berlin, Bruhns	Spot still seen.	

It is clear from the above that the direction of the spot from the nucleus relatively to the axis of the tail remained with scarcely sensible alteration for at least seven days, that is, between the 3d and the 10th of October. There are, however, in the more reliable positions, indications of a slight change, tending to diminish the angle. By making a suitable discrimination in the weights given to the observations, the better class show a diminution at the rate of about 1°.8 a day, although the amount of motion in the interval of seven days, being only 13°, cannot be considered as certainly recognized.

The deficiency of luminous matter, which gave the appearance of a dark spot, most probably extended through a considerable depth of the envelope, or it would

* By the figure, 260°, but the spot lies in about 23° less angle of position than the secondary nucleus, the latter having a measured angle of position = 262°.7.

scarcely have been so decided an object; we cannot, therefore, in taking account of the effect of a change of position in the Earth and Comet, consider it as merely superficial. With a considerable extension in the direction of the line of vision on Oct. 3d, it is not difficult to account for the permanence of the general direction of the spot, notwithstanding the Earth's relative rotation about the Comet, which, when resolved in the plane perpendicular to the radius vector, amounted to an angle of 43° between Oct. 3d and 10th. The following statements have been derived from a consideration of the relative positions occupied by the Sun, Comet, and Earth, during the interval covered by the observations.

1. If the centre of the spot had been so placed, relatively to the nucleus, that the plane of the Sun, Comet, and spot was inclined by 90° to the plane of the Sun, Comet, and Earth, at the earlier observations, then in order to preserve the observed direction relatively to the axis unchanged, the spot must have rotated at the rate of 6° daily about the radius vector of the Comet, in a direction to increase its longitude seen from the Comet, the latter being on the north side of the ecliptic.

2. Under similar conditions, if the direction of the spot from the nucleus had remained unchanged in space, the effect of the joint motion of the Earth and Comet would have caused $p'-p$ to diminish, bringing the spot seen from the Earth on the 10th of October in the vicinity of the vertex.

3. If the spot had been in the plane of the Comet's orbit, its direction inclined to the radius vector so as to satisfy the earlier observations and remaining fixed in space, $p'-p$ would have diminished by 3° daily.

4. The observed directions between Oct. 3d and Oct. 12th may be satisfied by supposing the centre of the spot to be nearly in the plane of the orbit, but inclined by a small angle, so as to bring it on the north side, and following the Comet in orbital motion. Its true direction from the nucleus, after being adjusted to satisfy the observations, remaining fixed in space.

5. The observed directions may also be satisfied without a rotation about the axis, if the true direction from the nucleus makes a constant angle with the radius vector, the spot being on the south side of the orbit and elevated by a small angle above it, and following the nucleus in orbital motion. This would imply a rotation nearly in the plane of the orbit, and sensibly equal to the change of direction of the radius vector.

6. The shortest period of rotation about the radius vector which can be made to represent the observations within admissible limits exceeds 30 days.

The annexed values of the angles ψ, comprised between the plane of the orbit

and the plane of the Comet, Sun, and Earth, will help to an understanding of the influence of perspective upon a section of the head of the Comet or of the envelopes by the plane of the orbit. The values of sin. ν are also added, ν being the angle comprised between the radius vector and the line from the Comet to the Earth.

1858. Sept. 8	$\psi = 0.6^\circ$	sin. ψ = 0.01	sin. ν = 0.60
12	4.1	0.07	0.70
16	7.6	0.13	0.80
20	11.5	0.20	0.90
24	16.5	0.28	0.97
28	24.6	0.42	1.00
Oct. 2	36.9	0.60	0.97
6	50.7	0.77	0.90
10	83.6	0.99	0.89
14	104.6	0.97	0.94
18	117.0	0.89	1.00
22	123.7	0.83	1.00

A bright mass of light, called by some the "secondary nucleus," appeared, on the 5th of October, in the vicinity of the dark spot upon *D*, lying between it and the nucleus, and a little lower down, or in a larger angle of position. Its neighborhood to the bright nucleus may have been the reason of its not having been seen a day or two earlier. Although observations upon it are less numerous than upon the dark spot, it was yet very generally recognized. It did not long retain its original brightness, but was diffused irregularly over a large area, which continued in sight, conspicuously brighter than neighboring regions, until the 11th. The following normal values have been derived from the observed differences between the angles of position of the bright mass and the axis of the tail, using also values read off from the figures.

Positions of the Bright Mass in D.

p = angle of position of the axis of the tail.
p' = " " " bright mass.

Oct. 5	$p' - p = 268^\circ$	Oct. 9	$p' - p = 262^\circ$
6	" = 250	10	" = 258
7	" = 260	11	" = 248
8	" = 259		

These numbers give no decided evidence of any considerable alteration in po-

sition; they offer, therefore, in this particular, a valuable confirmation of the observations on the dark spot which have just been under discussion.

It is very remarkable that the dark spot was repeated on the succeeding envelope, *E*, and in a nearly similar position; of this fact there is ample independent testimony. It is mentioned by Chacornac on Oct. 9th, by Peters, Oct. 10th, by Bond, Oct. 10th and 11th, and by Dawes on the 11th. The date of its first appearance, Oct. 9th, is important, for on this day the envelope had just risen from the nucleus, and the spot must have been a well-marked object to have attracted attention so early. In addition to descriptions, there are figures in which it is represented, by Peters, Oct. 10th, Bond, Oct. 10th and 11th, Dawes, Oct. 11th, and by Fette, Oct. 10th and 11th. Some traces of it were distinguishable on the 15th, and perhaps on the 18th. The observations generally indicate a direction somewhat nearer to the vertex than that occupied by the spot on *D*, the mean value of $p'-p$, having regard to weights, being

Oct. 11 $\qquad p'-p = 215°$.

A decided dark spot was also seen, Oct. 2d, on *C*, the envelope preceding *D*, with a bright ray below it, in the position, by a single observation,

	Dark Spot.	Ray.
Oct. 2	$p'-p = 250°$	$p'-p = 305°$.

The dark spot on *E* was also accompanied by an aggregation of bright nebulosity, mentioned by two or three observers, lying between it and the nucleus in the position

Oct. 11 $\qquad p'-p = 254°$.

Several others speak of a bright ray in this direction, which was undoubtedly the same object. A deficiency of light was also noticed in *F*, in the mean position,

Oct. 19 $\qquad p'-p = 228°$.

Another well-authenticated instance of the repetition of similar peculiarities in different envelopes, occurring in the same direction from the nucleus, may be recognized in a disposition of the nebulosity towards the upper and right-hand side of the envelopes, forming a brighter region, encroaching upon and partially filling in with light the dark arcs in that neighborhood. From the 6th of October to the end of the apparition, this offered a decided contrast with the aspect in the direction of the dark spots above described, outside of which the rim of the envelope was comparatively narrow, bright, and suddenly terminated by the dark arcs, which were here very prominent.

The mean of the observations upon the dark and bright spots in *C*, *D*, and *E* gives the following values: —

		Dark Spots.	Bright Spots.
Envelope C	Oct. 2	$p' - p = 250^\circ$	305°
" D	" 6	" $= 231$	259
" E	" 11	" $= 215$	254
" F	" 19	" $= 228$	....

An approach to the vertex is indicated, though not decided enough to be entirely certain; it is, however, similar to that noticed in the positions of the spots upon D, and is susceptible of a similar explanation.

The recurrence of these well-marked features in nearly the same direction in so many different envelopes suggests strongly the inference, that the nucleus itself maintained an aspect but little if at all altered with reference to the Sun, since it is to some peculiar condition in this centre of action that we must ascribe the diversified structure of the envelopes thrown off from it. The phenomena, at all events, can be so explained without resorting to any hypothesis of rotation, excepting in or near the plane of the orbit, and of an amount equal to the change in the direction of the radius vector. The length of time, also, during which the dark and bright spots maintained an unaltered position in the envelope, simply expanding as it rose, is quite in keeping with what has been remarked respecting the closed surfaces of the envelopes in their earliest stages, and their long persistence in the neighborhood of the nucleus. The so-called "secondary nucleus" was evidently a cloud of denser nebulosity, gradually diffusing itself as it ascended. It cannot be accounted for by any conceivable arrangement of the paths of particles issuing in a continuous flow from the nucleus outward into the tail, causing by their intersections the brighter masses, and in the regions of greatest separation, the dark openings. This idea of the structure of the envelopes has been very generally entertained, and derives its support from the frequent appearance of jets and rays issuing from the nucleus; but it will not explain many of the convolutions, and the occurrence of isolated bright masses and dark spots in a closed envelope is altogether opposed to it.

The material, after being thrown off from the nucleus, instead of being at once driven into the tail, formed a dense cloud of nebulosity, into which the luminous matter continued for some time to stream. This cloud extended itself on the sunward side, remaining in the vicinity for several days. When it had acquired a certain stage, the discharge took place mainly from the corners or cusps on either side, in two streams, which, coalescing with those issuing from other envelopes, formed the two branches of the tail. This seems to imply that the particles on the outer surface of the envelopes were the first to acquire that peculiar condition which subjected them to the influence of a repulsive force directed from the Sun.

We have, in this fact of the retention of the nebulosity in the head until the envelopes had acquired a considerable expansion, and of their subsequent dissipation principally from the sides, at points comparatively remote from the nucleus, a very simple explanation of the dark zone dividing the branches of the tail. It is the region scantily supplied with luminous material from the envelopes during the period occupied in their ascent from the nucleus to the point where their dissipation effectively began. If the particles composing different comets are supposed to acquire from the action of the solar repulsion different velocities under similar conditions in the same interval of time, we should expect, as a general rule, that comets, whose tails are composed of material impelled at a low velocity, and therefore most rapidly curved from the direction of the radius vector, would be those in which the branching would be most decided, and the envelope-formation would be exhibited with most deliberation and distinctness. On the other hand, those with tails in nearly straight lines, indicating a high degree of velocity, we should expect to be more tumultuous in their evolutions, manifesting in the contraction of their branching and in their envelopes the effects of more violent action. Probably a much larger number of comets than has commonly been supposed combine at the same time tails of widely different types, in which case their superposition one on the other must interfere with a clear apprehension of the details of each.

The succession of the envelopes, and especially the dark arc interposed between each and its predecessor, is a clear indication of the intermittent nature of the forces by which they are thrown off from the nucleus. The marginal rim was at first brightest at the vertex, and when at its most perfect stage, its appearance, bounded on either side by the dark arcs, indicated a shell-like figure thickest or densest at the top, and becoming thin at the sides, where it gradually faded away. That the density of the nebulosity at the moment of evolution from the nucleus should be greatest in a line with the Sun, has perhaps an explanation in the fact that the exciting cause of the phenomenon, viz. an influence directed from the Sun, would have its greatest intensity at this part of the surface, and would diminish towards the sides as the sine of the angle comprised between a line from the Sun and the tangent-plane to the surface.

In addition to the above, there may be other details of structure which might be recovered on a careful comparison of the data. The greatest difficulty lies in preserving the identity of objects, for the want of features prominent enough to afford certainty in their recognition from night to night. This, added to the large

errors of observation, will explain the confusion which will be met with in so many of the descriptions. Perhaps in no one particular has the difficulty of identification occasioned more perplexity, than in the attempts which have been made to decide the question of an oscillatory motion of the nucleus similar to that investigated by Bessel for Halley's Comet. This subject has been carefully discussed by Pape, Mädler, and Winnecke, by means of the observed directions of the middle line of the "Sector" or "Ausströmung." The fact that each has made use of his own observations secures them from any danger of misconception as to their precise significance, which might otherwise have arisen. The result has been, that in neither case was there found any distinct evidence of oscillation. Moreover, a comparison of the different series shows very plainly that there has been no kind of consistency between them.

The following are the differences between the direction of the Sun, p_0, and the observed angle of position of the middle line of the "Sector" or "Ausströmung" denoted by p', as given by Pape,* by Mädler,† and by Winnecke.‡

		Altona. Pape.	Dorpat. Mädler.	Poulkova. Winnecke.
		° ′	° ′	° ′
Sept. 17	$p_0 - p' =$	.....	− 8 24	.....
19	"	.....	+ 20 28	.....
20	"	+ 30 39	+ 32 43	.....
21	"	+ 45 44	+ 33 28	.....
22	"	+ 0 57	.....	.....
23	"	.....	+ 37 25	.....
24	"	.....	+ 25 24	.....
25	"	.....	+ 18 29	.....
26	"	.....	+ 12 57	.....
27	"	.....	+ 19 48	.....
28	"	− 2 10	+ 26 5	.....
29	"	+ 33 49	+ 28 3	.....
30	"	+ 7 8	+ 31 8	+ 0 48
Oct. 1	"	− 15 11	.....	.....
2	"	− 9 21	.....	.....
4	"	+ 16 40	.....	.....
5	"	− 17 53	.....	.....
6	"	− 8 38	+ 14 35	.....

* Astron. Nachrichten, 1172, p. 321.

† Beob. Kaiserl. Sternw. Dorpat, XV. pp. 54, 55.

‡ Pulk. Beob. des Grossen Cometen 1858, p. 44.

		Altona. Pape.	Dorpat. Mädler.	Poulkova. Winnecke.
Oct. 7	$p_0 - p' =$	$+ 7^\circ 33'$	$+27^\circ 5'$	$+ 0^\circ 12'$
8	"	$+10\ 40$	$+12\ 25$	$-14\ 30$
9	"	$+ 1\ 50$	$+ 7\ 58$	$-10\ 48$
10	"	$- 2\ 11$	.....	.....
12	"	$+22\ 13$	$+26\ 47$	.....
13	"	.....	$+29\ 51$	$-17\ 30$
14	"	.....	$+32\ 37$	.....
16	"	$-25\ 41$	.....	.....

There is here no trace of any law of periodicity, nor does it appear that the "Ausströmung," or middle line of the "Sector," was an object sufficiently well defined to serve the intended purpose, different observers evidently recognizing it in quite different features.

Some among the numerous jets or rays thrown out from the nucleus might perhaps be followed for a considerable length of time, but the uncertainty of identification is usually too great for them to be of much service in reference to the question of change of direction in the envelopes.

A change in the form and position of the envelopes nearest the nucleus will be noticed by referring to Plate XLIX.; the figures 17, 18, 19, 20, and 21, compared with 129, 132, 133, 134, 137, and 141, will serve to give an idea of its character. Notwithstanding the variety of configuration which appears on the Plate at different dates, the change, I am inclined to think, was gradual, the general direction between Oct. 2d and Oct. 11th bringing the transverse axis at right angles with the axis of the tail. In the interval between Sept. 23d (Figs. 17, 18) and Oct. 23d (Fig. 141), the alteration of the relative positions of the Earth and Comet was sufficient to cause an apparent rotation of the latter about its radius vector of 110°, the influence of which must be kept in mind in explaining the phenomenon; it is, however, in every way probable that there was a considerable change in the actual figures of the envelopes.

There was a well-marked exhibition of the envelope-formation in the Comet 1860, III., and still more decisively in the great Comet 1861, II. An engraving of the former, taken from a carefully executed drawing made at the Observatory of Harvard College, will be found on Plate LI.; we have here three distinct gradations of light, — a bright inner envelope, a middle one, bright, diffuse, and continued far into the tail, and an outer one, faint, but with outlines of singular clearness and delicacy, differing entirely from the ordinary aspect of the external haze surrounding the head of a comet.

There was a peculiar disposition of the light in the head of this Comet which could easily be followed from night to night. The subjoined differences between its angle of position and that of the tail show that its general direction suffered no change large enough to be certainly recognized, in an interval of fifteen days.

1860.	June 21	$p' - p = 219^\circ$	June 27	$p' - p = 260^\circ$
	22	" $= 201$	28	" $= 248$
	24	" $= 228$	July 1	" $= 221$
	25	" $= 236$	6	" $= 236$
	26	" $= 206$		

In the great Comet 1861, II., eleven envelopes were seen between July 2d, when portions of three were in sight together, and the 19th of the same month, a new one rising at regular intervals on every second day. Their evolution and dissipation were accomplished with much greater rapidity than was the case with the great Comet of 1858, an envelope requiring but two or three days, instead of almost as many weeks, to pass through all its phases. The phenomenon of the bright jets issuing from the nucleus was also more conspicuous. Altogether there seemed to be a higher degree of activity, but less regularity and persistence. The forms of the inner envelopes were singularly like some of those of the last-named Comet, such, for instance, as that represented in the engraving for Oct. 18th, Plate XLIV., which is an almost perfect counterpart of the envelope on July 5th, 1861.

By rare good fortune, their development was followed, at the Observatory of Harvard College, from July 2d, 1861, to July 21st, inclusive, with the interruption of but a single cloudy night, that of July 14th. This secured the identification of the principal features, which would otherwise have been scarcely possible on account of their short duration. Perhaps the most interesting of these was the repetition on each envelope of a peculiar and easily recognized conformation, retaining a constant direction relatively to the axis of the tail up to July 30th, an interval of four weeks. This fact, taken in connection with the relative positions occupied by the Comet and the Earth, implies that the nucleus had no oscillation of a perceptible amount, nor any rotation excepting in a sense preserving the same aspect to the Sun. From the longer period covered by data, this conclusion is better established than the similar inference to which we have been led in the case of the Comet of 1858.

The two comets differed remarkably in respect to the branching of the tail, of which that of 1861 presented scarcely a trace. Here, obviously, the intervening

space was filled with material impelled at a comparatively high velocity on its way to form the straight bright ray constituting the principal tail. At times, indeed, a narrow bright beam, occupying the central line, could be plainly traced to this destination.

It is obvious that, in order to keep the vertices of the envelopes constantly interposed between the Sun and the nucleus, there must be a rotation in the plane of the orbit equal in amount to the heliocentric motion of the Comet. In each of the examples which have been adduced, we find that the phenomena can be accounted for sufficiently well by supposing that the nucleus itself maintains the same aspect relatively to the envelope, thus reproducing similar features always in the same direction. It follows that the nucleus must have had a rotation in the plane of the orbit corresponding in amount with the change of direction of the radius vector. If this be admitted, whether accompanied or not by periodical oscillations, it shows that the Sun exercises a controlling directive force, and is so far in accordance with Bessel's theory of the polarization of the nucleus. That the reaction from the escaping jets and sectors should communicate oscillations to the whole body, seems probable. Of this, however, we find no distinct traces in either of the three comets here described.

XIII. ON THE OUTER FAINT VEIL.

This feature has escaped general observation, owing partly to its faintness, but as much, perhaps, to the large area which it occupied taking it beyond the region in the vicinity of the nucleus, which was chiefly scrutinized. Notices of it will be found in Section VIII., as follows: —

Poulkova, Struve,	Sept. 17, 18, 24, 27, 30; Oct. 5, 7, 9.
Poulkova, Winnecke,	Sept. 16, 17, 18, 25, 27, 30; Oct. 5, 7, 8, 9.
Breslau, Galle,	Oct. 4, 5, 6.
Copenhagen, D'Arrest,	Sept. 28? 29?
Christiania, Fearnley,	Oct. 3.

It is represented on Plate XLIX., Figs. 10, 11, 25, 32, 36, and 40. Figs. 110 and 120 also may refer to it. The faintly indicated figures on the Poulkova Plates II., III., IV., and VI. were not noticed by the engraver in making the copies upon Plate XLIX.

Most observers have remarked the want of symmetry in the position of the "Umhüllung" relatively to the nucleus and axis of the tail; its distance from the latter being greatest on the apparent right-hand side, and its central line inclining towards the same direction. The great extent of this envelope towards the Sun, compared with that of the principal mass of nebulosity, will hold an important place in any investigation of the dimensions of the Comet's atmosphere, if such is supposed to exist.

A phenomenon of perhaps the same nature was seen in the Comet of June 1860 (1860, III.). Its appearance is represented on Plates L. and LI. In this instance, although the whole mass of outer nebulosity was quite faint, the outlines were presented with singular sharpness and delicacy; it was visible, however, on two evenings only, June 27th and 28th.

XIV. ON THE DIRECTION OF THE INITIAL AXIS OF THE TAIL.

The deviation of the direction of the initial axis of the tail from the prolongation of the radius vector has been discussed by several astronomers with the same general result, — that, after the middle of September, when the observations first became numerous, the tail was not seen projected in a straight line from the Sun, but inclined backward, as respects the orbital motion, by a small angle. The values of this angle at different dates will be found in Section III. pp. 95 and 96. It has been shown further by Pape,* and by Winnecke,† that the observed directions may be satisfied reasonably well during the interval, if the axis of the tail is supposed to be in the plane of the orbit, and inclined to the radius vector prolonged, by a constant angle. This angle, according to Pape, is 6° 18′, from observations at Altona, Poulkova, and Dorpat. Winnecke finds 3° 46′, using his own observations by themselves.

The subjoined numbers give the position of the axis at near the time when the Earth passed the descending node of the Comet's orbit. p denotes the observed angle of position, and p_0 the direction of the great circle from the Sun through the nucleus.

* Astron. Nachrichten, 1173, pp. 328–330. † Pulk. Beob. des Grossen Cometen 1858, pp. 64, 65.

G P Bond Del. J. W. Watts Sc.

COMET III 1860.

JUNE 27TH 8H 40M M.S.T. OBSERVATORY OF HARVARD COLLEGE

Printed by Chas. D. Andrews

Sept. 1	Berlin, Förster	$p_0 - p =$	$-\ 6\overset{\circ}{.}5$
2	Poulkova, Struve	" $=$	$-\ 8.8$
2	Poulkova, Winnecke	" $=$	$-\ 5.7$
4	Poulkova, Winnecke	" $=$	$-\ 5.2$
7	Berlin, Förster	" $=$	$-\ 5.5$
11	Poulkova, Winnecke	" $=$	$-\ 2.4$
11	Collegio Romano, Secchi	" $=$	-10.3
12	Poulkova, Winnecke	" $=$	$+\ 0.4$
13	Berlin, Förster	" $=$	$+\ 2.5$
13	Poulkova, Winnecke	" $=$	$+\ 0.2$
15	Berlin, Förster	" $=$	$+\ 2.5$
16	Poulkova, Winnecke	" $=$	$+\ 0.9$

The mean of these reduced to the date of the Earth's passage through the plane of the orbit is

$$\text{Sept. 8} \qquad p_0 - p = -3\overset{\circ}{.}9\,;$$

indicating that the axis of the tail was inclined by this amount to the plane of the orbit. It must be remembered, however, that at this time the Comet was too near the horizon and too deep in the twilight to admit of being well observed. On the other hand, there was already a sensible excess of brightness in the apparent right branch of the tail, which might, under these unfavorable conditions, incline the observed direction towards this branch. This would have the effect of increasing p; in other words, it would give, as above, a negative value to $p_0 - p$ at the date of the Earth's crossing the plane of the orbit.

XV. CONCLUSION.

It will be useful to bring under one view the principal phenomena exhibited by the Comet during the entire apparition, and the conclusions to which the discussion of the observations has led. For this purpose, a review of the contents of the several Sections is here subjoined.

Section I. contains the details of observations upon the figure, dimensions, and position of the tail in its whole extent.

The statement of these details has been made, as far as possible, in the form of quotations taken *verbatim* from the various authorities, with full references for

verification or comparison. They have been arranged in the order of dates, and alphabetically on the same date in the order of the observers, and are accompanied by remarks calling attention to the more important particulars. In all, sixty-seven authorities are cited, representing fifty-one stations or points from which observations have been taken.

The whole period of visibility of the Comet extended from June 2d, 1858, to March 4th, 1859, an interval of two hundred and seventy-five days. It was seen with the naked eye from Aug. 19th to Dec. 9th, one hundred and twelve days. The tail appeared first on Aug. 14th, 1858, and was in sight until Feb. 9th, 1859, or for one hundred and seventy-seven days.

The contrast in the density of the two branches of the tail, which distinguished it during almost the whole apparition, was noticed very early. The order of brightness was not changed by the Earth's passage through the plane of the orbit, which took place on Sept. 8th; the plane through the axis and the bright branch must therefore at this time have had a considerable inclination to the orbit. The curvature of the tail, if the observations previous to the passage of the Earth over the line of nodes may be trusted, was then either out of the plane of the orbit, or else in a direction to bring its extremity in advance of the radius vector.

The bifurcation or distinct separation of the two branches, though indicated nearly a month earlier, first became a conspicuous feature about the middle of September, when the phenomena of the envelopes also began to appear. From this time up to the 8th or 10th of October, the expansion of the tail went on with great rapidity, checked only by the light of the moon, which was full on the 22d of September, and continued to interfere more or less with the visibility of the Comet for four or five days later. The most imposing view was presented between the 30th of September and the 10th of October; the brilliant front edge was strongly contrasted with the fainter branch, which seemed to lose itself insensibly upon the dark sky without having at any point a decided margin. A dark, intermediate channel near the head could be discerned with the naked eye, though much more plainly with the telescope. The upper regions, at the date last named, were diffused faintly over a large expanse of sky, ten or fifteen degrees in breadth, the extremity attaining a distance of over 60° from the head. After the 10th of October, the Comet faded away even more suddenly than it had appeared, becoming reduced within a week to a comparatively insignificant object. The details of several peculiarities not mentioned above are given in other Sections. The aspect of the tail to the naked eye, with the neighboring constellations, is represented on Plates I. to XXIII. inclusive, and its outlines on Plates XXIV., XXV., and XXVI.

Section II. comprises observations upon the secondary tails. These consisted chiefly of long, narrow, and nearly straight rays, the first of which was noticed on the 17th of September, and continued in sight a little more than three weeks. They were quite faint, and escaped general notice. Their appearance is represented on Plates V. to XIX. inclusive.

Section III. gives the details of the reduction of the observations upon the figure and position of the tail. This was accomplished by means of charts on a special projection, designed to present the curves of the front and rear edges free from considerable distortion, throughout the entire interval covered by the observations. The projection is a development upon a cylinder tangent to a great circle nearly coincident with the middle of the brighter part of the tail in all its positions, from the middle of September to the middle of October. In extreme cases, the exaggeration of the scale of projection may amount to one sixteenth part, at a distance of 33° from the nucleus. The angles of position of neighboring points are given throughout in correct proportions.

The stars in the region occupied by the Comet, together with the place of the nucleus, and the initial axis of the tail, for 7^h m. s. t. at the Observatory of Harvard College, were inserted on the charts, and, finally, the observed positions of points in the tail. The latter were then reduced on each date to the same epoch, and combined in normal curves, as represented upon Plates XXIV., XXV., and XXVI., Sections I., II., and III.

In the course of the discussion, the effects of twilight, and moonlight, and of the altitude of the Comet above the horizon at the times of observation, have been specially examined with reference to the conditions, more or less favorable, for its visibility. From this it appears, that the Observatories of Northern Europe were, on the whole, best situated for viewing the Comet during the more interesting part of its apparition. All the results for the length and breadth of the tail have been grouped together for ascertaining the adopted values. The maximum length was 64° on the 10th of October; the greatest breadth was 18° on the day following. At the end of the section is a table of the concluded right ascensions and declinations of points on the front and rear outlines.

In Section IV. are considered the probable errors affecting the observations upon the tail. It is shown: —

1. That the errors for points not very near the nucleus, under similar circumstances in other respects, increase proportionally with the increase of the angular distance of the point observed from the nucleus.

2. That the errors increased progressively with the time, from the earlier to the latest observations.

The first result is explained readily as a consequence of the increased diffusion of light in proceeding upward from the nucleus. The second is plainly due to the effect of a nearer approach to the Earth, and also, after the perihelion, to the dissipation of the nebulosity of the tail, and its diminished brightness.

The probable errors of the concluded outlines are finally investigated, and the results given in a tabular form for each date. At a distance of 10° from the nucleus, they vary from ± 3′.4 on Sept. 30 to ± 30′.5 on Oct. 17.

Section V. describes the deflection of the upper part of the tail, — a peculiar disposition of its light, first noticed at the end of September, which gave the impression of an abrupt change of direction in the line of principal brightness, as though a confused and scattered mist had been left behind by the denser portions of the tail, or had been driven off from it by an opposing blast. The effect of the deflection manifests itself most strongly in tracing the axis of brightness, as represented on Plates XXV. and $\mathrm{XXV}_{(a)}$. It was most evident about the 8th of October, when the distance of the light-axis from the front edge was, for the higher regions, about 6° or 7°.

Section VI. describes the columnar structure, or the division of the upper part of the tail into alternating dark and bright bands, disposed transversely to the axis at angles of 20° or 30°. A very remarkable feature, though indistinctly seen and described.

Section VII. contains the reduction of observations on the secondary tails. The results are exhibited on the chart, Plate XXIV. The principal ray attained a length of 55°.

The original data relating to the envelopes and nucleus, and to the phenomena of the head of the Comet generally, are comprised in Section VIII. The citations are made from seventy-one authorities, representing fifty-one stations; the plan of arrangement being the same with that adopted in Section I.

The peculiar difficulties of observations of this class are made very sensible, by the discrepancies which manifest themselves on a comparison of the data. To some extent, these may be referred to differences in the optical capacity of the instruments employed. With a view to this circumstance, a list of the various telescopes used has been prefixed to the statement of the observations, by means of which some discrimination may be exercised as respects the amount of confidence to be given to the different descriptions. It would, however, be a most unsafe practice to be always guided in this particular by the single consideration of the greater or less optical power at the disposal of the observer, since many other conditions are to be regarded as equally requisite for a clear apprehension

of the phenomena; for instance, the continuity of the observations in point of time, without interference from clouded skies or other interruptions in the series, necessarily entailing confusion in the relation of the different phases of development.

The first traces of a peculiarity in the nebulosity near the nucleus, which led finally to the full development of the envelopes, are mentioned on Sept. 11th. The light was seen streaming outward from the nucleus on the side next the Sun, and bending backward to form the two branches of the tail; on the side turned away from the Sun, the nucleus remained well defined, as also on subsequent dates. This appearance was not essentially altered, except in acquiring greater decision, until the 20th, when a dark arc, interposed between the nucleus and the Sun, gave the outline to the first completely formed envelope. Their subsequent history will be noticed more fully in another connection.

At the close of Section VIII., besides observations of a miscellaneous nature, which could not be conveniently arranged under any particular dates, there have been introduced collections of observations relating to the brightness of the Comet, and to the polarization of its light.

Section IX. treats of the outline of the head of the Comet. The discussion is based upon one hundred and twenty-three outlines, derived from the original drawings or engraved figures. These have been combined in fifteen normal curves, as represented on Plate XLVII., and also in the normals for Sept. 17th, 30th, Oct. 7th and 14th, in the upper group of curves on Plate XLVIII., and finally for Oct. 4th, in the lower group.

After an examination of the breadths of the projected outline of the head at different distances from the vertex, furnished by the telescopic observations, the character of the curve representing the apparent outline, as seen projected upon the plane of vision, has been investigated, together with the corrections required to reduce the outline for the effect of perspective. Comparing the results with observation, it appears that the limiting surface of the head of the Comet had a close resemblance to a surface generated by the revolution of a catenary on its vertical axis; the distance of the nucleus from the vertex being very nearly one fourth (0.242) of the breadth of the catenary at a point in the axis where the distance from the vertex is equal to the breadth measured through the same point.

It is remarkable that, although in the interval between the dates of the normals on Plate XLVII. the direction of the line of vision had changed from a position a little removed from the plane of the orbit on one side to one almost at right angles to it on the other, the Earth meanwhile having accomplished a virtual rota-

tion about the radius vector of the Comet amounting to 121°, at the same time changing by nearly 90° the angle between the line of vision and the radius vector, the form of the apparent outline and the position of the nucleus relatively to the vertex were scarcely affected.

The phenomena of the branching and central darkness of the tail have been considered in Section X. On the 24th of August, the right branch already showed an excess of light, and the contrast in density went on increasing until it reached a maximum about the time of the perihelion passage. Between the 4th and 10th of October, the left branch became relatively the brightest, or was at least not inferior to the other. The envelopes were also now decidedly brightest on this side. A conspicuous dark zone separated the branches after the 20th of September, its central line inclining to the apparent left of the axis of the tail, leaving the right-hand branch broader than the other. This zone, at first narrow and dark, gradually widened, and became less distinct. Its increased breadth and the approach of the Comet to the Earth caused an appearance in the telescopic view of an increased divergence in the branches of the tail. Besides the dark zone, there was a much narrower dark canal with straight sides, which could be traced quite to the nucleus, where its outlines were very clearly defined; close in the rear of the nucleus it seemed as dark as the background of the sky. It inclined to the apparent right-hand of the axis of the tail, bringing it nearer to the direction of the radius vector. This dark canal has not commonly been distinguished by observers from the zone. A few remarks have been added relating to the branching of the tail in the Comet 1860, III., figures of which have been given on Plates L. and LI.

The size of the nucleus, and the quantity of light emitted by it and by the head generally, form the subject of Section XI. The diameter of the actual solid nucleus must have been less than five hundred miles; the increase of size at the larger distances from the Earth and Sun, which is clearly indicated by the observations, was probably the effect of the dense haze of nebulosity surrounding it, which prevented its true limits from being seen. A change of diameter which may be similarly explained was apparent at the rise of each new envelope.

From the fact that the principal brightness of the head of the Comet was always disposed on the sunward side of the nucleus, the observations of its position must refer to a point nearer the Sun than the actual nucleus, and it may reasonably be inferred that, to a greater or less extent, the same is true of all comets.

On the 2d of October, when the brightness of the head of the Comet reached its

maximum, it was 6300 times brighter than on June 15th, the increase by observation exceeding that computed by the usual formula of the product of the inverse squares of the distances from the Sun and Earth, by *thirty-three* times. The difference may be referred to an increase in the aggregate reflecting surface of the Comet. No account is here taken of the light transmitted from the tail, which would have very much increased the discrepancy. The proportion of light concentrated in the telescopic nucleus was greatest before the evolution of the envelopes. On the 19th of August, it comprised *one third* of the whole light, but at near the time of maximum brilliancy this proportion had diminished to *one sixtieth*, or by some estimates to as low as *one two-hundred-and-fiftieth*.

The phenomena presented by the envelopes are considered in Section XII. One of the most important of these is their regular succession and continuous ascent or expansion outwards from the nucleus. To establish this fact, which supplies a principle of continuity in their aspect at different dates, and is accordingly very essential to a correct understanding of their history, the measurements made at the Observatory of Harvard College are first discussed and arranged, and the order of succession and rate of evolution derived from them has been employed to elucidate the observations made at other stations. It has been found practicable to reconcile the larger part of the data in this way, the exceptions being neither more frequent nor more considerable than might have been anticipated from the difficulties of the observation. Seven distinct envelopes have, in this way, been recognized, and their history partially recovered.

The whole of the measurements upon each envelope, including readings from drawings and engravings, have been reduced to a series of normal values, which have finally been referred to the unit of distance from the Earth. Those relating to the apex of the outline show a tendency to a diminished rate of ascent at larger distances from the nucleus, although it cannot be ascertained with entire certainty from the measurements upon the vertices taken by themselves, since this part of the outline was first dissipated, and consequently did not afford so long an interval for the comparisons.

To account for the crowding or compression of the inner envelopes upon the outer, three explanations are suggested: —

1. That the elevation-velocity may have been least in the earlier envelopes, causing them to be overtaken by their successors. On this point it is shown that the measurements present no such tendency in the initial velocities, but rather the contrary.

2. It is supposed that the intervals between successive envelopes may have

been least in the earlier members of the series, so as to produce the appearance in question. But this also is opposed to the observations.

3. The remaining hypothesis, of a progressive diminution in the velocity of expansion for each envelope, is fully sustained by their measured breadths, in which a change of velocity is clearly exhibited.

The period between the elevation of the envelopes is found to have varied irregularly from 4 days 16 hours to 7 days 8 hours.

The forms and characteristic features of the envelopes are next considered. At first they presented a variety of aspects, but as they expanded they tended to conform with a normal type, the light becoming more evenly disposed and the outline more symmetrical. For a few days the surface was closed on the side opposite to the Sun, although here and there penetrated by streams issuing into the tail, principally from the cusps on either side. As it expanded, the discharge became general, but was always most considerable from the outside, thus forming the asymptotic branches below the nucleus. The curve on the side towards the Sun in a completely formed envelope was very nearly circular for 60° or 80° on either side of the axis. This was originally the brightest and best-defined region, but it was also the first to fade away, the material being evidently transferred to the outlines below the parallel of the nucleus, which remained in sight long after the upper portions had disappeared, and finally driven off into the tail. The process of dissipation furnishes a satisfactory explanation of the branches of the tail, which are simply the continuation of the older envelopes merged together and undistinguishable from each other excepting near the nucleus. In this view the dark hollow of the axis represents the region not fully supplied from the envelopes, while they retained their closed, or partially closed surfaces.

From the fact that some part of the materials of an envelope remained near the nucleus for a long time before their expulsion into the tail, — in one instance, at least, as long as eighteen days, — it may be inferred that the particles do not at once acquire the property which subjects them to a solar repulsion, but that a change is effected gradually. Again, the dispersion taking place chiefly from the outside shows that it is the surface particles which first attain that condition, and which are the first to leave the vicinity of the nucleus.

After reference to the dark arcs interposed between adjoining envelopes and the bright marginal rims of the latter, the subject of the dark and bright spots on their surface is taken up. Several results of considerable importance have been derived from the discussion. Among them are, —

1. A degree of permanence in the internal distribution of the substance of the envelopes retained for a long interval after their ejection from the nucleus.

2. That their diversified aspect, especially the isolation of bright masses, cannot be explained as a mere optical effect produced by the intersection or separation of streams of luminous matter passing out continuously from the nucleus into the tail.

3. The nearly permanent direction maintained by the spots relatively to the axis of the tail proves that there was no sensible rotation of the envelopes, excepting in a sense always preserving an unaltered aspect towards the Sun.

4. That there was no sensible oscillatory motion of the nature of that seen in Halley's Comet, as described by Bessel.

5. The repetition of spots and rays, and other similar peculiarities of structure in successive envelopes, in nearly the same direction, strongly indicates that the nucleus itself constantly maintained the same aspect towards the Sun, without sensible rotation other than is implied in this condition, and without oscillation. This result, notwithstanding the absence of observed oscillations, implies the action of polar forces upon the nucleus in the manner suggested by Bessel in his explanation of the phenomena of Halley's Comet.

From an examination of the direction of the central line of the luminous sector, it is concluded that no trace of periodicity or continuity of any kind is exhibited. The object was evidently not sufficiently well defined to be certainly recognized, observers on the same night differing so entirely from each other as to induce a suspicion that the identity on different nights is not to be trusted.

The Section concludes with a notice of the envelope-formation of the Comet 1860, III. and of the great Comet 1861, II., in both of which the permanent direction of characteristic emissions from the nucleus was repeatedly noticed; in the former, through an interval of two weeks, and in the latter, of four. The great Comet 1861, II. presented a succession of eleven envelopes rising at regular intervals on every second day. Their evolutions and final dissipation were accomplished with much greater rapidity than the corresponding phenomena of the Comet of 1858.

It may be proper to add, that, in comparing the above conclusions with observation, the alterations in the relative positions of the Earth and Comet have been taken into account wherever necessary.

Section XIII. gives an account of the outer faint veil, or "Umhüllung," with a reference to a similar feature in the Comet 1860, III.

Section XIV. relates to the deviation of the initial axis of the tail from the direction of the radius vector prolonged.

The preparation of the present volume has been attended with much unnecessary difficulty, arising from the defective methods of observation and description apparent in a large proportion of the published accounts of the Comet. A few words on this subject, by way of suggestion to future observers of Comets, will not be inappropriate in this connection.

First, as regards the figure and position of the tail, respecting which the materials for discussion, considering all the circumstances, have been particularly unsatisfactory. No method is so exact and so easily applied, as to trace the outlines and peculiarities of structure upon accurate *star-charts*, employing the naked eye, assisted occasionally by a good opera-glass and comet-seeker. It is especially desirable that the figure and character of the light should be noted as far from the head as it is possible to trace it. The best form of publication will be a simple transfer from the charts.

For the telescopic phenomena the first care of the observer should be to execute a faithful drawing of the Comet. The micrometer should next be applied to ascertain the scale of the figure, and to verify the position of the best defined features. Written notes should accompany and explain the drawing, designating expressly the features most easily recognized, so as to offer the means of distinguishing between them, and others only faintly seen or merely conjectural.

The main point to be kept constantly in view, is the superiority of good charts and drawings to mere verbal descriptions. Of course, in the publication, engravings will be indispensable.

Attention to these suggestions will tend to elevate the character of the observations, and very much facilitate their subsequent discussion.

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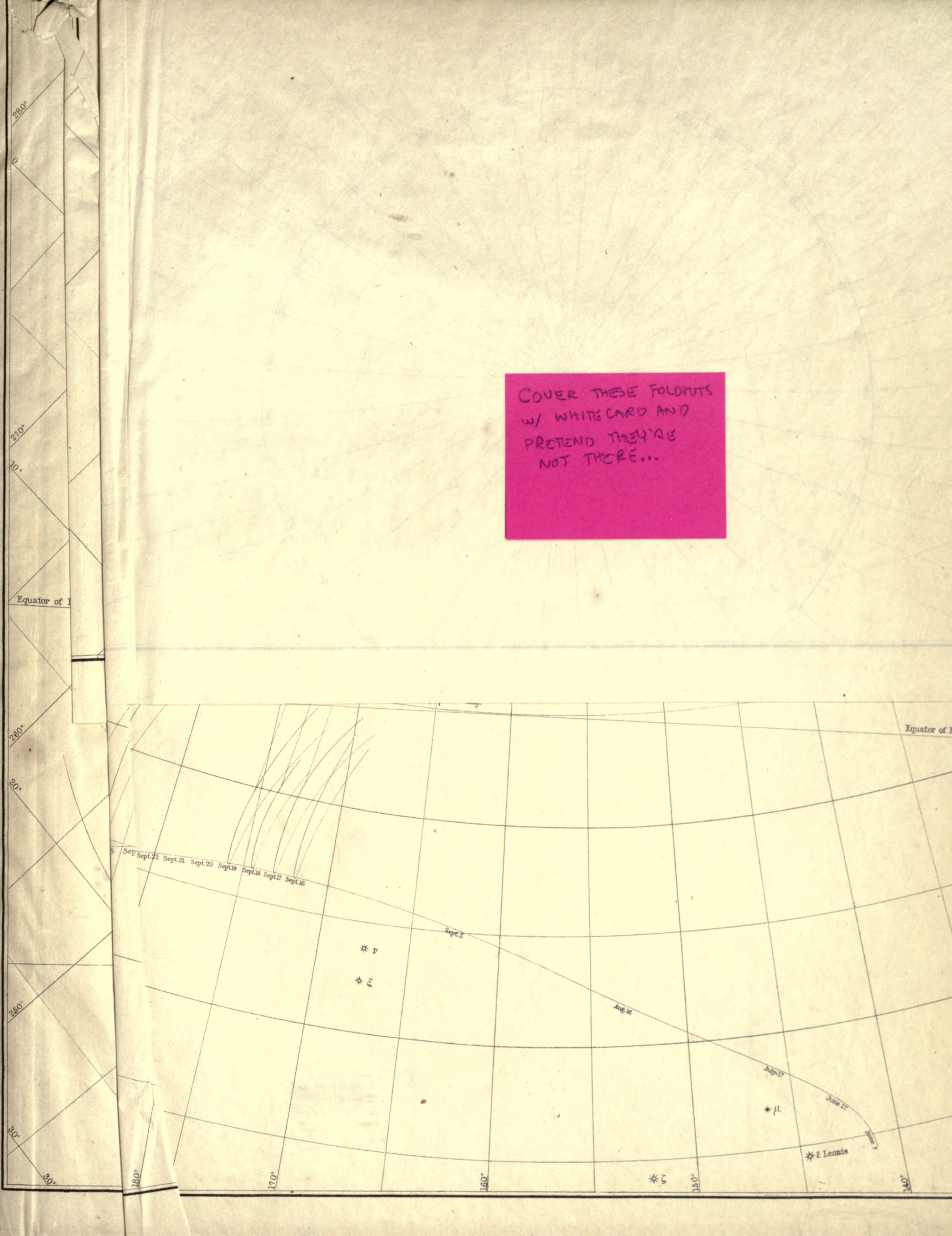
COVER THESE FOLDOUTS
w/ WHITE CARD AND
PRETEND THEY'RE
NOT THERE...



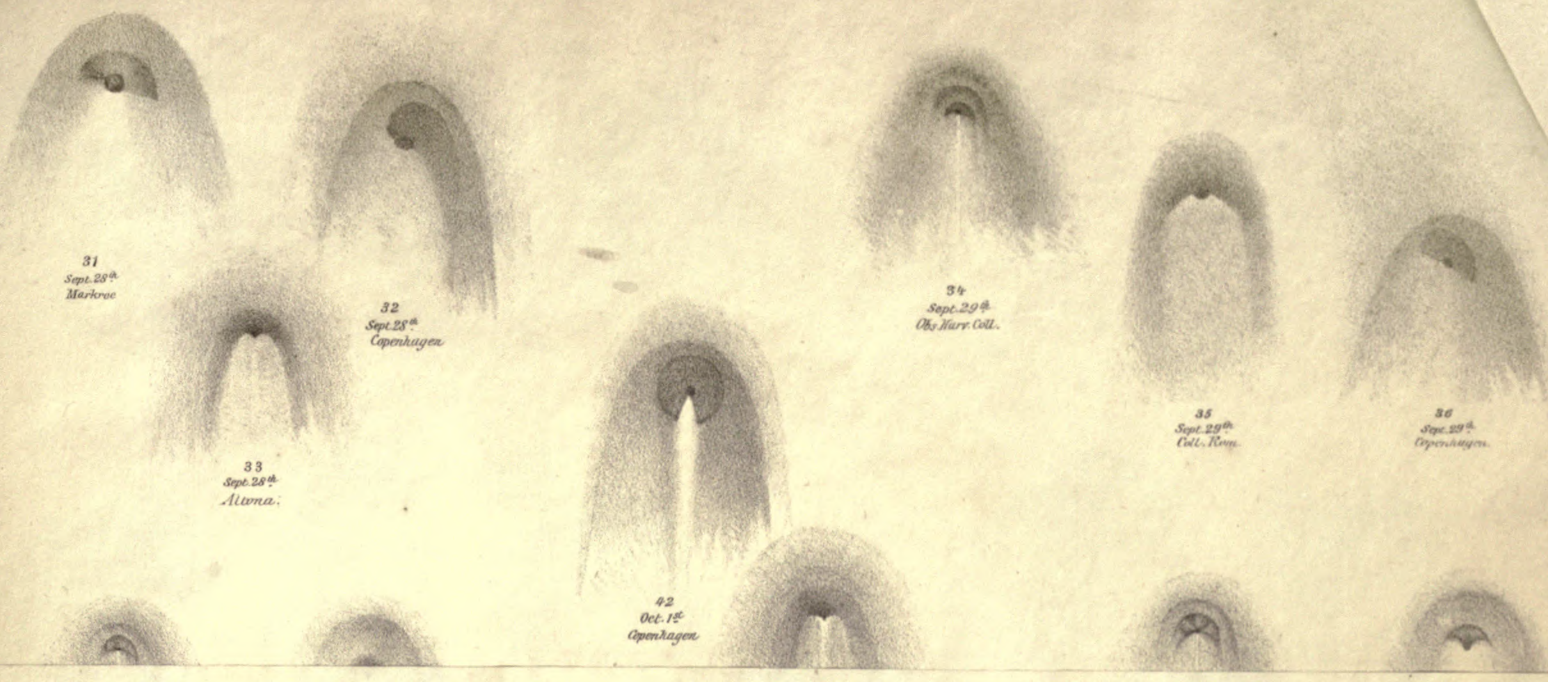

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PLATE XLIX